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ABSTRACT

Provided are hearings related to perfecting the goals/objectives of S. 248, the Excellence in Science and Mathematics Education Act of 1983. Various issues related to the current crisis in science/mathematics education and to improving the quality of education in these areas in the United States (with particular emphasis on New Mexico) are addressed in testimony presented during the hearings. Among the areas considered are: U.S. education compared with foreign countries; declining enrollments; science and mathematics teacher quality/improvement; regional science resource centers; science/mathematics education for American Indians and for rural school children; financial support (including teacher salaries); incentives for science/mathematics teachers; industry role; teacher-industry relationship; and need for scientific/technologically literate citizens. Supporting documentation, including additional statements, letters, and a newspaper article are included in an appendix. Also included (in the body of the hearings) is a paper entitled "Can Science Education Cope with the Information Onslaught?" which was prepared during a 1981 conference at the Los Alamos National Laboratory. (JN)

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SCIENCE AND MATH EDUCATION

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HEARINGS

BEFORE THE

COMMITTEE ON THE BUDGET
UNITED STATES SENATE

NINETY-EIGHTH CONGRESS

FIRST SESSION

ALBUQUERQUE, N. MEX.
FEBRUARY 7, 1983

LAS CRUCES, N. MEX.
FEBRUARY 11, 1983

U.S. DEPARTMENT OF EDUCATION
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SCIENCE AND MATH EDUCATION

MONDAY, FEBRUARY 7, 1983

U.S. SENATE,
COMMITTEE ON THE BUDGET,
Albuquerque, N. Mex.

The hearing was convened, pursuant to notice, at 1:02 p.m., in the board meeting room of the Albuquerque Public School System with Hon. Pete V. Domenici presiding.

Present: Senators Domenici and Bingaman and New Mexico Senator Tim Jennings and New Mexico Representative Sam Vigil.

Senator DOMENICI. This hearing will come to order.

I think the staff has done a marvelous job of getting things ready here. I note that the only thing they forgot was the gavel. I assume that means that this is expected to be a very orderly hearing, not like some that I have to conduct in Washington, but we will find something up here to get some order. I think this ashtray will work.

Let me first thank the two members of the Budget Committee staff who worked very hard on this, Joyce Purcell and Jan Lilja. We are most appreciative of your work.

And now let me tell you how pleased I am that Senator Bingaman has joined us.

While he does not serve on any committee that I am on and not on the committee that I Chair, I asked him to come. I look forward to working with him on this and other issues of general interest to New Mexico. I hope that he will enjoy being with us today.

I look forward to Senator Bingaman's participation in these hearings as we attempt to perfect the goals and objectives of S. 248, the Excellence in Science and Mathematics Education Act of 1983.

The legislature of the State of New Mexico is extremely interested in science and math education, in particular, the Senate and House Education Committees. We are pleased that a number of these legislators both Democrat and Republican, are here with us today.

I have asked the two education committee chairmen to join us here on the dais. I would like to introduce them, then I will proceed to my opening remarks.

Senator Bingaman will have his remarks. In addition we have invited our two legislators to make some brief remarks.

On Jeff's left is Senator Tim Jennings, chairman of the Senate Education Committee from Chavez County.

Senator, you are welcome and we are delighted to have you here with us.

On my right is Representative Sam Vigil, who Chairs the New Mexico House Education Committee and represents the counties of San Miguel and Guadaloupe.

I understand that in addition to the two chairmen, Senator Lois Hall from here in Bernalillo County is with us.

Would you please stand? Thank you very much for being with us, Senator.

On your side, Sam, I understand that Representative Norma Hood from Bernalillo County was scheduled to be here.

Representative VIGIL. Yes, she was coming in but is probably not here yet.

Senator DOMENICI. All right. Representative Richard Knowles from Travis, Debacua and Lincoln counties, thank you very much for being with us.

Representative Murray Ryan and Representative Mary Tucker from Dona Ana were not able to attend.

Representative Luis Sanchez, we are pleased to have you. Thank you for coming.

Now, Senator Bingaman, unless you had anything that you wanted to say up front, we will proceed.

We have a very full afternoon. I am going to say right up front that I would very much appreciate the witnesses doing their best to follow our general instructions that staff has conveyed to them.

We have some witnesses that we could not accommodate. I will announce what we are going to do with their statements soon but let me take a couple of minutes to tell all of you why I think we are here.

I have already welcomed all of you.

OPENING STATEMENT OF CHAIRMAN DOMENICI

NEW MEXICO HIGH-TECHNOLOGY STATE

We know that our State is, for many reasons, unique. We have within our borders one of the highest concentrations of science and technology in the country. We have two nationally recognized laboratories, Los Alamos and Sandia, which conduct some of the finest research and development in the country.

Fifteen thousand professionals in engineering, technology, and science live in this State. New Mexico has in recent years become an increasingly attractive State to industry, particularly high-technology industries. I have every reason to expect that this trend will continue and if we do some things right, that we may accelerate it significantly.

This concentration of science and technology makes New Mexico keenly aware of what we have in this regard and what we will need to do to ensure a prosperous future.

I am delighted to welcome our witnesses. Not only do they have the unique insight that comes from living in this technology-intensive State, each also represents a specific area of expertise, which will be very valuable as we discuss what I feel is a serious and growing national problem.

It has to do in a very real way with the education of our children and the future of our country. I am afraid that we have reached a

point where we take America's extraordinary technology achievements for granted. We think that our research and technology is now, has always been and will always be and that it will be first.

I believe that if we do not sit up and take notice of what is going on, we can look forward to a dim future economically, technologically, and internationally.

SHOT IN THE ARM NEEDED TO STIMULATE EDUCATION

Ernest Boyer, a former U.S. Commissioner of Education, was quoted in the New York Times as saying, and I quote, "Between 1958 when Sputnik occurred and 1975, half a million secondary school teachers in math and science and languages had gone through summer workshops to raise their skills."

He continued on, saying, "Maybe what we need is another Sputnik."

Continuing on, "Maybe what we should do is get the Japanese to put a Toyota into orbit." End of quote.

Let me list a few of the disturbing facts.

One—every standardized test used to measure science and math capabilities has shown a steadily declining level of achievement over the last 10 years. Between 1975 and 1980, remedial mathematic enrollments at our 4-year institutions of higher education increased 72 percent while total student enrollment increased by only seven.

At a public 4-year college, 25 percent of the mathematics courses are remedial and at a community college, 74 percent.

Since the 1970's, high school and college admission requirements for math and science have been significantly lowered from prior years.

Fourth—only one-sixth of all high school students have taken junior or senior math courses. Two-thirds of the country's high schools require just 1 year of math to graduate.

One-third of the 21,000 U.S. high schools teach calculus and fewer than one-third offer physics courses taught by qualified physics teachers.

Thirteen percent of all high school graduates are prepared for engineering curriculum in college compared with 28 percent in 1972.

In a survey conducted by the National Governors Association, 43 of 45 States reported a critical shortage of math teachers; 42 percent reported a shortage of physics teachers, and 38 percent reported a shortage of chemistry teachers.

According to the National Science Board in 1980 and 1981, experienced math and science teachers left their jobs at the rate of 4 percent a year. Another 25 percent expressed the intention to leave in the near future.

A continuation of this trend will result in a net loss of 35 percent of the country's math and science teachers by 1992.

HALF OF NEW TEACHERS JUDGED UNQUALIFIED

Among newly employed science teachers and math teachers, 50 percent were judged by their principals as being unqualified to teach the subject.

Surveys indicate that among present math and science teachers, 79 percent have not completed a 10-hour workshop or course in their subject in over 10 years; 69 percent have never attended a computer course of any kind and 40 percent have not attended a continuing education course since they began.

I do not believe that our students have become duller or less capable of learning. I have eight children of my own. To admit that would, in a very real sense, be admitting to guilt on my part genetically and extreme culpability on their part.

The problem is simply that we need more and better qualified teachers. We must do whatever is necessary to reverse the trends that I have just outlined.

I have additional facts in my opening remarks. I will not give them. I will make them a part of the record.

If the United States is to regain and maintain its economic prosperity over the years, there is no doubt in my mind that we must reverse the trend in the areas that I have just described.

There may be others but this is almost a sine qua non.

In my opinion, there will be legislation adopted in this area. Even though we are worried about huge deficits, there is no doubt in my mind that this curative problem will receive attention.

I am pleased to indicate to you that I am told by my staff that the Chairman of the House Committee on Education, Distinguished Representative Perkins from Kentucky, recently indicated upon seeing S. 248, "If the U.S. Senate passed a bill similar to S. 248, it could be a short conference."

Congressman Perkins indicated that he would be delighted to go to conference and get the legislation to the President's desk.

I do not know that that is so. I heard it. I am pleased if it is true.

FEATURES OF DOMENICI EDUCATION BILL

The three main functions of my approach are to establish a student scholarship and teacher award program to be administered by the National Science Foundation with State oversight through commissions on excellence.

Second, States would be required to establish commissions on math and science excellence. There is criteria for the commissions. If States already have an existing body that fits the critieria, fine. If something needs to be added to fit the critieria, fine.

Last but not least, the bill would amend chapter 2 of the Education Consolidation and Improvement Act to establish a science and education block grant program administered through State departments of education.

The authorization level in the bill will obviously be discussed. Some will think it is too high, others will think it is too low. The level that I have chosen, $200 million with no match required. It is available to all who meet the criteria outlined and can be used for a myriad of purposes which are set forth as guidelines.

Thank you for your patience.

[Prepared statement of Senator Domenici follows:]

OPENING STATEMENT

BY

SENATOR PETE V. DOMENICI

SCIENCE AND MATHEMATICS EDUCATION

I want to welcome and thank our witnesses for coming here today. We all know that New Mexico is, for many reasons, unique. We have, within our borders, one of the highest concentrations of science and technology in the country. We have two nationally recognized laboratories, Los Alamos and Sandia, which conduct some of the finest research and development in the country. We also have very strong universities, such as the New Mexico Institute of Mining and Technology and New Mexico State University. New Mexico has, in recent years, become increasingly attractive to industry, particularly high technology industries. As our universities and the laboratories work more closely together, I have every reason to expect that this trend will continue.

This concentration of science, research, education and technology makes New Mexican's keenly aware of what we have now, and what we will need to do to ensure a prosperous future.

I am delighted to welcome our witnesses. Not only do they have the unique insight that comes from living in this state, each also represents a specific area of expertise which will prove invaluable as we discuss what I feel is a serious and growing national concern--the education of our children and the future of our country.

I am afraid that we have reached a point where we may be taking America's extraordinary technological achievements for granted. We

think that our research and technology is now, has always been, and will always be -- first. Well, I will tell you, if we don't sit-up and take notice of what is going on in education, we can look forward to a dim future economically, technologically, and internationally.

Ernest Boyer, a former U.S. Commissioner of Education was quoted in the New York Times as saying: "Between 1958, when Sputnik occurred, and 1975, half a million secondary school teachers in math, science and languages had gone through summer workshops to raise their skills --- Maybe what we need is another Sputnik --- Maybe what we should do is get the Japanese to put a Toyota into orbit."

Let me list just a few of the disturbing facts which describe the nature of the problem:

(1) Every standardized test used to measure science and math capabilities has shown a steadily declining level of achievement over the last ten years.

(2) Between 1975 and 1980 remedial mathematics enrollments at four-year institutions of higher education increased 72 percent while total student enrollment increased by only 7 percent. At public four-year colleges, 25 percent of the mathematics courses are remedial, and at community colleges, 74 percent.

(3) Since the 1970's high school and college admission requirements for math and science have been significantly lowered from prior years.

(4) Only one-sixth of all high school students have taken junior or senior math courses. Two-thirds of the country's high schools require just one year of math to graduate.

(5) Only one-third of the 21,000 U.S. high schools teach calculus and fewer than one-third offer physics courses taught by qualified physics teachers.

(6) Today, 13 percent of all high school graduates are prepared for the engineering curriculum in college compared with 28 percent in 1972.

(7) In a study done by the National Governors Association, 43 of 45 states reported a shortage or a critical shortage of math teachers; 42 reported a shortage of physics teachers, and 38 reported a shortage of chemistry teachers.

(8) According to the National Science Board, in 1980 and 1981, experienced math and science teachers left their jobs at the rate of 4 percent. Another 25 percent expressed their intention to leave in the near future. A continuation of this trend will result in a net loss of 35 percent of the country's math and science teachers by 1992.

(9) Among newly employed science and math teachers, 50 percent were judged by their principals as being unqualified to teach their subject.

(10) Surveys indicate that among present math and science teachers, 79 percent have not completed a 10-hour workshop or course in their subject in over 10 years, 69 percent have never attended a computer course of any kind, and 40 percent have not attended a continuing education course since they began teaching.

I do not believe that our students have become duller or less capable of learning. The problem is that we need more teachers and better qualified teachers. We must do something to reverse this trend.

The Bureau of Labor Statistics projects that the demand for scientists and engineers to fill science and engineering occupations will increase by 40 percent between 1978 and 1990. Projections indicate that 180,000 new jobs will be available in the mathematical, physical and life sciences, 250,000 in engineering and -- the profession expected to experience the greatest demand -- 480,000 in the computer field.

Who is going to fill these jobs? How can we possibly expect to meet this demand if we do not do something to improve the math and science competency of our high school graduates? How are we going to do that without the teachers qualified to teach them?

Education of our workforce is the single-most important effort we can make to improve our nation's long term productivity trend and sustain our international competitiveness in key world markets.

Improvement in the quality of our labor force, through better basic education and training is the single most important contributor to our long-term productivity growth. Conversely, erosion in the quality of our labor force during the past decade has been the single largest contributor to the decline in our nation's productivity growth. Productivity is essential if we are to maintain price stability in this nation. It is essential to our international competitiveness. It is essential if we are to improve the standard of living in this nation. And, I must say, that American productivity is challenged by our competitors in the international marketplace.

Higher productivity and more rapid long-term economic growth are also essential to improving our overall budget situation and helping us put Americans back to work. We need to find ways to use our limited resources to improve the growth of the nation's economy.

We are now faced with budget deficits larger than any ever experienced in our nation's history. The President's budget forecasts 3.1 percent real growth in 1983 and 4.0 percent real growth in 1984 through 1988. If actual real growth is one percentage point lower than forecast each year, the budget deficit will be $83 billion higher by 1987. If the actual unemployment rate is 1 percentage point higher than forecast, it will add $37 billion to the deficit by 1987. It is clear that both strong economic growth and lower unemployment are necessary to improve the budget outlook.

No Senator has worried more about the effect that large deficits will have on our economic recovery. I have come to the conclusion, however, that we must plan for a long-term economic recovery, not a one to two year cycle of prosperity. We cannot afford to lose a generation of scientists and experts. We must make an investment in science and math capabilities to ensure that America can compete and that our future will be prosperous.

I hope that the math and science education bill which I have introduced will help to halt the declining achievement in these critical areas, will serve to encourage teachers who are already in the schools to stay, and will motivate young people to pursue teaching degrees in these subjects.

It is essential that we recognize this problem and deal with it expeditiously. To borrow an analogy from Carl Sagan of Cornell University... We are in a position of eating the seed corn. Here we are in the midst of a tough winter. We have stored some seeds of corn to plant next year. We know we can get through this winter if we eat the seedcorn, but then we will be in desperate straits the next winter since we will not have planted the crop for our future survival. I think we had better plant the crop.

I hope for us all, that Congress will act on this measure with some sense of urgency, so that we may begin to reverse the trends that threaten to hold us back in science in technology. We do have budget problems that we must solve, but we cannot forget the reason that we have become an international leader with one of the highest standards of living in the world. Our future depends on our children and the education they receive in our school systems.

Again, welcome to our witnesses. I look forward to hearing what each of you have to say on this important issue.

Senator DOMENICI. I am delighted to yield to my good friend, the new Senator from New Mexico, Senator Bingaman.

OPENING STATEMENT OF SENATOR BINGAMAN

Senator BINGAMAN. Thank you very much, Pete.

Let me make some very brief remarks here. I want to first thank Senator Domenici for inviting me to participate in the hearing today. Obviously, the subject matter of the hearing and of the legislation that he has introduced is crucial to New Mexico in particular because of the tremendous talent we have in this State in the science and math fields.

I share his concerns about the future scientific strength and technological capability of the country. These concerns are related directly to the quality of the scientific education that our children receive and the number of students who enter the scientific fields for study.

These issues are of increasing concern to people throughout the country because of our competitive position internationally.

SCIENCE AND MATH PLACED HIGH OVERSEAS

You and I have heard the statistics on the emphasis that countries such as Japan and the Soviet Union place on science and math education. This is in sharp contrast to our own situation here in the United States. It is clear that we must make every effort to reemphasize training and education in these areas.

A technologically skilled work force knowledgeable in both theoretical and applied sciences is critical to maintaining our country's competitive position as a world power. Maintaining this work force is dependent on the quality of students we produce in our public and private schools and universities.

This, in turn, is related, to the numbers of qualified instructors available to teach in these areas.

I recall, when I started college in 1961, that one of the first books we were required to read was C. P. Snow's book on Two Cultures. Unfortunately, over 20 years later, the problem that he identified there is still very much with us.

Clearly, scientific illiteracy is one of the main problems facing our country today.

It is clear to me when I go into any department store that science and technology have outstripped our ability to use those skills.

NEW PROGRAM MUST BE LASTING

One thing which I would particularly like to try to learn something about in today's hearing is how we, as a country, can set up a program in this area which will be sustained over a period of time. It is clear to me that one of the problems we have had in the United States is that we tend to get very enthusiastic about a particular activity for a couple of years but then we back off from it.

When Sputnik went up, I was in high school. Everybody was gung-ho about learning math and science. Had that effort been followed through on, there would be no shortage of math and science teachers today. Clearly, it was not followed through to the extent it

should have been and now we are back at ground zero trying, once again, to give proper emphasis to this area.

As you know, we can cite a lot of other areas such as energy independence where our country has gone through periods of concern and lack of concern. I hope that the witnesses today will help us to identify a way to not only address the problem this year, but one way that will be sustained over a long enough period that the problem will, in fact, be dealt with. Thank you.

Senator DOMENICI. Thank you very much, Jeff.

Tim, would you like to make a few brief remarks?

OPENING STATEMENT OF NEW MEXICO STATE SENATOR TIM JENNINGS

Senator JENNINGS. Yes, Senator.

First, I would like to thank you for bringing this hearing to New Mexico. I think you realize some of the problems we have had in education. Your bill recognizes the fact that we who are in education are all concerned and we need to take a giant step toward preparing our children for the future.

EDUCATION LACKING IN FOUR AREAS

In my opinion, there are four main areas in education that I see that we are lacking in the State of New Mexico as a general rule.

One is in the area of mathematics. The state of New Mexico requires one unit of mathematics. One of the books that was on the State-certified adoption list, is clearly, in my opinion, fifth grade level work, at the most, sixth grade.

Along with this, I have concern in the area of social studies. We also need more laboratory and computer sciences and more foreign language.

Why these four areas? The United States is facing a crisis of astronomical proportions. Our children are living in a nation which is not preparing them to compete in the world. How we respond to this crisis will determine whether or not our children will be able to enjoy the same standard of living that we enjoy here today or if we are going to sit by and let the United States slip into what I consider to be a second-class status in the world of education and the world in which we live.

It sounds a little dramatic but just look at a few of the statistics. In 1970, none of the European Common Market countries had a greater gross national product than the United States yet in 1980, 11 out of the 14 Common Market countries surpassed the United States in GNP.

That is just 10 years. We have gone from first to 11th or 12th. In 1970, 9 percent of the U.S. gross national product resulted from exports; in 1980, it was 29 percent. That is an increase of 20 percent in just 10 short years. I think we can all see what we are coming up to.

The United States is not isolated. We are in a world market.

Recently, Japan ranked first of 19 nations in an international comparison of science and math achievement. It was not too long ago that the United States would have been first. But now we are only 15th out of 19 nations.

STUDENTS HIGHLY MOTIVATED

Is there the difference? Is it the money we spend on education? No, not hardly, because we spend more on education in the United States per capita than any other nation in the world.

Is it the pupil-teacher ratios? We have all heard that one. That cannot be. Japan was No. 1 and Japan's average pupil-teacher ratio is 40 to 1. Ours is 19.1 here in New Mexico.

Is it technology and computers in the classroom? Not really, Japan has very little use of computers in their classroom.

Then what is the difference? Why? What are we doing wrong?

In my opinion, the difference is pretty fundamental. It is basically, what you learn is a function of what you study and how hard you study it.

In Japan, where the educational system has rules that are very clear, school meets for 240 days a year. Ours is 180, two full months longer that they spend in the classrooms.

Their students are highly motivated because of just plain competition, the thing that built our country to be as great as it is.

I am not advocating that we need to copy the Japanese educational system but I do think what we need to do is make our American system tougher, set higher standards and demand that from our children.

Our education requirements need to respond to the changing world every day. We cannot sit back and get complacent which, in my opinion, is what we have done here in New Mexico.

Right now, our industries need more and more people trained in science and math and high technology. Be it vocational or academic, either way, the children of our State need to be trained in an area in which they can compete.

More and more, our engineers are coming from foreign countries rather than the United States.

This leads to my final requirement. That is the United States isolationism here. We sit here in the United States. We have no foreign language that we teach basically in our school system. In New Mexico, there are no foreign language requirements.

Yet, together we have already seen in the last 10 years our exports have gone from 9 to 29 percent. We sit here and think that everybody should learn English just for us. You know, maybe sometime or another, maybe we ought to look around and see that we are all in it together and the world economy is moving together at a very rapid pace.

I think that we really need to strengthen our foreign language requirements.

The issue is becoming simpler and simpler to understand. It is, one, when are we going to start taking our schools more seriously again? When are we going to stop graduating students merely because they put in the hours? When are we going to start believing in our young people—and I mean believe in them?

MAKE SCHOOLS TOUGH

Strengthen your requirements. Make it tough. I think our young people want to be challenged. And I do not think that any of the young people I have met in going around really want to be second-

rate and I do not think any of them are willing to concede to a second-class standard in the world we live in today.

Last but not least, I would just like to say, thank you, Senator Domenici and Senator Bingaman, for putting this conference together because although it is not going to be the final solution, it is certainly one of our first steps in the right direction.

Thank you, sir.

Senator DOMENICI. Thank you very much.

Sam. Or maybe I should call you Mr. Chairman?

Representative VIGIL. No, just Sam is fine, thank you.

Senator DOMENICI. All right.

OPENING STATEMENT OF NEW MEXICO STATE REPRESENTATIVE SAM VIGIL

Representative VIGIL. Senator Domenici and Senator Bingaman and, of course, my colleague, Senator Jennings, I really did not expect to sit up here and make a presentation, so my remarks are going to be very brief.

I simply would like to say that we certainly thank your staff for making it possible for us to attend and the Department of Education for making it possible for us to get up here. It is our pleasure to be here, Senator. We are here to learn more than to profess.

I think basically everyone is aware of the fiscal dilemma that besets us at both the national level and certainly at the State level. The question of priorities is something that our committee is very much concerned about as to how are we going to dedicate the money that we have and what is the best investment that we can make for the State of New Mexico?

As education is really, essentially, the responsibility of the States, it puts a kind of awesome responsibility on those of us that happen to be in the position of making those decisions.

We feel that math and science is basic in whatever the Federal aid that can be made in that direction. We certainly would like to be included in knowing what the process would be for making this possible to our children.

I think the communicative skills should not be neglected in the whole process but that is something that can be tied up with whatever the general proposals are, Senator.

I would like to simply say that we are very happy to be here. We appreciate the opportunity to listen to some of the people that are going to testify.

I am sure that the House committee that I happen to Chair will deliberate long after this presentation to see what we can do for New Mexico, Senator.

Thank you very much.

Senator DOMENICI. Thank you very much.

One announcement. It was impossible for us to take testimony from everyone that wanted to appear so I want to acknowledge some written testimony that will be submitted for the record.[1]

We do not have time today or in our hearing in Las Cruces to listen to them all but I am pleased that many have taken it upon themselves to put their thoughts down on paper.

[1] Written testimony submitted for the record can be found beginning on p. 213.

I would like to acknowledge written testimony for the record and it will be made a part of the record, from Thomas Villarreal, Jr., president and executive director of the National Institutes for Multi-Cultural Education; Mel Root, superintendent of schools for Mountain Air Public Schools; and Bob Fisher from the Los Alamos Laboratory.

Their statements will be made a part of the record.

Now let us proceed. I do now have a gavel. It does not look like mine but thank you. It perhaps belongs to your board. I appreciate it.

The first panel will be made up of three people,

Dr. Robert Thorn, Deputy Director of the Los Alamos Scientific Laboratory; Dr. Robert MacPherson from Signetics Corp., plant manager here; William Snyder, Director of Nuclear Fuels Programs at Sandia Laboratories, and last but not least, a man that I am very proud of and was privileged to work for in the Senate who has now been confirmed as a Presidential appointee, Dr. Manuel Justiz, the Director of the National Institute of Education.

I welcome you here, Manuel.

Now, would the panelists please assume their chairs and we will start their testimony.

I will announce a change. Instead of Mr. Snyder, we are most privileged to have George Dacey, the Director of Sandia.

We are delighted to have you, George. I saw you here. I wondered if you were just going to be a guest. I should have asked.

Dr. DACEY. Well, I originally could not make it but another meeting was cancelled and so I decided I should come myself.

Senator DOMENICI. We are going to proceed now. You each are supposed to limit your testimony to 5 minutes. Your written remarks, so we will not have to state it over and over, will be made a part of the record.

And we will start with Dr. Thorn. We welcome you here, Doctor.

STATEMENT OF DR. ROBERT THORN, ASSOCIATE DIRECTOR, LOS ALAMOS SCIENTIFIC LABORATORY

Dr. THORN. Thank you. I appreciate the opportunity to appear before you to discuss the important and far-reaching legislation that you have introduced to reverse the downturn we have seen in the U.S. science and mathematics education.

U.S. EDUCATION CONTRASTED WITH FOREIGN COUNTRIES

As the 1980 National Science Foundation report, "Science and Engineering Education for the 1980's and Beyond," points out,

> Declining emphasis on science and mathematics in this country is in marked contrast to the emphasis of other industrialized countries such as Japan, Germany, and the Soviet Union which provide rigorous technological training for all their citizens.

Senator Domenici's bill overall will help our schools fulfill their role in science and technology education and help to increase the public understanding and appreciation of the importance of excellence in these areas.

It is clear, I think, that we are in trouble with the teaching of science and mathematics to our secondary school students in the United States.

We recognize this in our recruiting efforts for staff at the Laboratory and it is gaining attention in national arenas.

"SCANDAL" IN SECONDARY EDUCATION

The current president of the American Physical Society is physicist Robert E. Marshak. He recently addressed a joint meeting of the society and the American Association of Physics Teachers and pointed out that the number of new mathematics teachers fell 77 percent in the last 10 years and the number of science teachers declined 65 percent.

In his speech, Marshak said, and I quote:

> We are facing a crisis, "Scandal" may be a more appropriate word, in secondary school education.
>
> In the past year, more than one-half the teachers who received emergency certification as science instructors were unqualified.

The bill being introduced by Senator Domenici, the National Math and Science Excellence in Education Act of 1983, gets at the heart of the problem in providing specific incentives to encourage university students and teachers to prepare for teaching careers in mathematics and science.

Our experience at the laboratory with science and mathematics training in State schools stems from two areas.

First, we have an outreach program where we try to reach out to the schools in northern New Mexico. For example, we sent teams of laboratory employees to visit 36 junior high schools to encourage careers in science and engineering, visited with about 3,000 elementary school students to introduce energy awareness and develop interest in science, provided hands-on training for 100 high school students from Pojoaque, Espanola, and Los Alamos in an after-school program running for two semesters, mounted a 2-day teachers' workshop on computers in schools, hosted 800 high school seniors at the 26th Annual Science Youth Days for a 1-day seminar including tours, lectures, and demonstrations.

In a second arena, that of employment, we hire significant numbers of scientists and technicians to work at the laboratory. In the course of recruiting the technical staff we pinpoint the kinds of education and training necessary to fulfill very specific technical specifications.

In 1981 and 1982, the laboratory hired 424 scientific staff members, including practicing engineers, scientists and technical managers primarily performing professional technical research and development activities.

Since many of the specific technical skills we require are quite narrow, we advertise nationally for staff members. We do very well in attracting talent and staff and in competing on the national market. I would like to point out that 11 percent of the staff members hired in the last 2 years received their education at New Mexico institutions of higher learning.

MINIMALLY QUALIFIED HIRED

In hiring 317 technicians in the last 2 years, we have faced a much more difficult situation. Technicians are technical employees and crafts workers who provide support and expertise to research

and development activities. In this area, we compete for staff in local markets only and we have been in the position of having to hire minimally qualified personnel and to provide remedial training on the job.

How well the laboratory is able to continue competing for well-trained and technically competent staff depends in good measure on the ability of secondary schools to graduate students with skills adequate to meet college-level and technical training entrance requirements in a time of drasitcally increasing demand.

The present situation is not encouraging. In the course of working with our educational outreach programs at Los Alamos, we surveyed 17 high schools in the seven northern counties in New Mexico.

Fifteen schools teach high school level courses in chemistry, 12 teach trigonometry, 11 have courses in physics, and only 7 have courses in calculus.

I would like to conclude my remarks by stating that both from a national perspective and from our particular vantage point it is clear that the need is acute for legislation such as that proposed by Senator Domenici.

Thank you.

Senator DOMENICI. Thank you very much, Dr. Thorn.

Jeff, unless you have objection, we will have them all testify and then inquire. However, as they testify, if anything comes to your mind, do not hesitate to ask. Sometimes it gets a point across better that way.

Did you read your entire statement or do you need a part of it made a part of the record?

Dr. THORN. I presented, I believe, a statement for the record.

Senator DOMENICI. Fine.

[The prepared statement follows:]

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

REMARKS OF ROBERT N. THORN
DEPUTY DIRECTOR
LOS ALAMOS NATIONAL LABORATORY
BEFORE THE
SENATE BUDGET COMMITTEE
ALBUQUERQUE, NEW MEXICO

FEBRUARY 7, 1983

Mr. Chairman:

I appreciate the opportunity to appear before you to discuss the important and far-reaching legislation that Senator Domenici has introduced to reverse the downturn we have seen in United States' science and mathematics education. As a 1980 NSF report, "Science and Engineering Education for the 1980's and Beyond," points out, the declining emphasis on science and mathematics in this country is in marked contrast to the emphasis of other industrialized countries, such as Japan, Germany and the Soviet Union, which provide rigorous technological training for all their citizens. The report goes on to note that the schools of this nation only reflect our national commitment in any area and, thus, are not so much a cause as a result of current public opinion. Senator Domenici's bill, overall, will help our schools fulfill their role in science and technology education and help to increase public understanding and appreciation of the importance of excellence in these areas.

It is clear, I think, that we are in trouble in the teaching of science and mathematics to our secondary school students in the United States. We recognize this in our recruiting efforts for staff at the Laboratory and it is gaining attention in national arenas. The current president of the American Physical Society (APS) is physicist Robert E. Marshak. He recently addressed a joint meeting of APS and the American Association of Physics Teachers and pointed out that the number of new mathematics teachers fell 77% in the last ten years and the number of science teachers declined 65%. In his speech, Marshak said, "We are facing a crisis--scandal may be a more appropriate word--in secondary school education. In the past year, more than half the teachers who received emergency certification as science instructors were unqualified."

An Equal Opportunity Employer/Operated by University of California

The bill being introduced by Senator Domenici, The National Math and Science Excellence in Education Act of 1983, gets at the heart of the problem in providing specific incentives to encourage university students and teachers to prepare for teaching careers in mathematics and science. The establishment of State Commissions on Mathematic and Scientific Excellence and block grants to states for the improvement of math and science education will go far in providing the infrastructure, tailored to each state's needs, to put the teaching of science and mathematics on a more solid footing than has been the case recently.

Our experience at Los Alamos National Laboratory with the science and mathematics training in state schools stems from two areas. First, in 1980, we established an educational outreach program with the goal of sharing an awareness of current technology in science and engineering with northern New Mexico educators and students and encouraging young people in the seven northern counties to stick with their science and math courses in order to pursue technological careers. To this end, we have in 1982:

- Sent teams of Laboratory employees to visit 36 junior high schools to encourage careers in science and engineering.
- Visited with about 3000 elementary school students to introduce energy awareness and develop interest in science.
- Provided hands-on science training for 100 high school students from Pojoaque, Espanola, and Los Alamos in an after-school program running for two semesters.
- Mounted a two-day teachers' workshop on computers in the schools.
- Hosted 800 high school seniors at the 26th annual Science Youth Days for a one-day seminar including tours, lectures, and demonstrations.

In a second arena, that of employment, we hire significant numbers of scientists and technicians to work at the Laboratory and, in the course of recruiting the technical staff, we pinpoint the kinds of education and training necessary to fulfill very specific technical specifications. In 1981

and 1982, the Laboratory hired 424 scientific staff members, including practicing engineers, scientists, or technical managers primarily performing professional technical research and development activities.

Since many of the specific technical skills we require are quite narrow, we advertise nationally for staff members. We do very well in attracting talented staff and in competing on the national market. I would like to point out that 11% of the staff members hired in the last two years received post-secondary education at New Mexico institutions of higher learning. We would like to increase the number of New Mexican students we hire into scientific positions at the Laboratory and have several special employment programs to encourage this. The most important of these, in terms of the number of students involved, include the graduate assistant program, the summer undergraduate program, and the undergraduate cooperative program.

In hiring 317 technicians in the last two years, we have faced a much more difficult situation. Technicians are technical employees and crafts workers who provide support and expertise to research and development activities. In this area, we compete for staff in local markets only and we have been in a position of having to hire minimally qualified personnel and to provide remedial training on the job.

So much for recent past history in the Laboratory's experiences in finding technical staff. The future outlook for hiring at the Laboratory is fairly stable, with increased emphasis on defense programs, especially in the weapons research area. This will require significant scientific manpower in the coming decade because of the increase in nuclear weapons research, weapons testing, and new defense systems. It is important to point out that the Laboratory's needs encompass many scientific endeavors, as well as weapons design. Just as breadth in technical expertise and understanding is essential in weapons, so is it similarly needed in many other fields, from the investigation of fundamental research to the applications of technology to industry; from understanding the biological behavior of a gene to developing a microprocessor for computers or a robot for working in a hazardous environment.

How well the Laboratory is able to continue competing for well-trained and technically competent staff depends in good measure on the ability of secondary schools to graduate students with skills adequate to meet college level and technical-training entrance requirements in a time of drastically increasing demand. The present situation is not encouraging. In the course of working with our educational outreach programs at Los Alamos, we surveyed 17 high schools in the 7 northern counties of New Mexico: 15 schools teach high school level courses in chemistry, 12 teach trigonometry, 11 have courses in physics, and 7 offer courses in calculus.

In 1981, at a conference on science and the information onslaught held at Los Alamos, five scientists presented a paper entitled, "Can Science Education Cope With The Information Onslaught." The answer to that question was a resounding "No," assuming that present trends continue. Some of the proposals for strengthening science education included in the paper are also highlighted in The National Math and Science Excellence in Education Act of 1983 and I have attached a copy of the paper for your reference.

Both from a national perspective and from our particular vantage point, it is clear that the need is acute for legislation such as that proposed by Senator Domenici. We would anticipate that with the emphasis on secondary teaching of science and mathematics provided in The National Math and Science Excellence in Education Act more high schools would be able to provide the basic courses that students need to pursue further training in science or go directly into technological careers. We heartily endorse the objectives of the bill in general and anticipate that the bill will help to meet our specific needs for a technically trained work force. Meanwhile, Los Alamos National Laboratory pledges to continue its support to the New Mexico public school system and we hope that more teachers, students, and school administrators will take advantage of the programs we offer.

"PROCEEDINGS OF THE CONFERENCE ON SCIENCE AND THE INFORMATION ONSLAUGHT"

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

June 1, 1981

CAN SCIENCE EDUCATION COPE WITH THE INFORMATION ONSLAUGHT?

by

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I. Current Challenges to Science Education

In evaluating the responses by society and by the scientific community to what has been termed the "information onslaught," it is essential to consider the state of science education in relation to anticipated needs. Over the next 25 years, continued rapid advances in scientific theory, in mathematics, and in computer science will necessitate improved preparation of students in these disciplines. We will need physical scientists, social scientists, business executives and government leaders who can organize and advance rapidly changing fields. We will need humanists who can evaluate and interpret the meanings for society and for the individual of vast new bodies of scientific and technological information. We will also need a general public whose members are sufficiently literate scientifically to evaluate important issues of public policy, to function as employers, employees, and consumers in new technological environments, and to find individual and personal fulfillment despite the bewildering and sometimes alienating effects of changing technology. As new orders of magnitude occur in the amount and complexity of the information which human society generates and processes, these needs become more and more urgent.

When we examine some present trends in science education in the United States, the situation appears extremely discouraging. For example, the recent results of the National Assessment of Educational Progress indicate achievement trends which are less than adequate in relation to the present goals and standards of public education.[1] Yet present high school level standards generally do not include (except for perhaps the most select and talented students) even a qualitative

understanding of many major 19th- and 20th-century mathematical and scientific achievements, such as non-Euclidean geometries, quantum theory, relativity theory, or the theory of the genetic code.[2] In addition, while many high schools and some elementary schools are acquiring small computers, school curricula still make little use of computers or computer science. Recently, George A. Keyworth, science adviser to President Reagan, noted the extreme inadequacy of classroom laboratory equipment in colleges and universities. It thus appears that with respect to curriculum content, materials, and student achievement in science, the situation is rather bleak.

Trends are no more encouraging when one looks into the matter of science teachers. According to a 1981 survey conducted by the National Science Teachers Association, the average age of secondary school science teacners is 42. One third of these teachers majored in college in non-science subjects. About half of the teachers have had no inservice courses lasting a week or more during the past three years; likewise half have had no college science course for five years or more. Nearly a third of the science teachers in the U.S.A. expect in the near future to leave the profession.[3]

There are also developments in the area of teacher education which are disturbing. As colleges and universities evaluate their teacher certification programs in response to mandates from state governments, increasing emphasis is being placed for all new teachers on expansion of pre-service field experiences, on multicultural education, and on special

education (education of the handicapped, mentally retarded, gifted, etc.). These new requirements are in themselves laudable. However, they are frequently being met in institutions of teacher education by the expedient of adding new courses to existing sequences, rather than by modernizing the content of the traditional courses in educational psychology, social foundations, educational measurements, and methods and materials.[4] This results in a pre-service curriculum skewed away from the subject area content necessary for the science or mathematics teacher to handle effectively the information explosion in these disciplines.[5] In addition, as entry level requirements for the teaching profession increase without a concomitant rise in the salary and status of the schoolteacher, we can expect increasingly severe shortages of teachers in those disciplines where the competition from other professions is keen--namely mathematics and science.

For certification at the secondary level, most institutions require a major or at least a strong minor in the certification area. However, at the elementary school level, one or two semester courses are frequently all that the student is required to take in college mathematics or science. Izaak Wirszup has compared science education in the Soviet Union with that in the United States, noting for example the extensive science requirements for children in the U.S.S.R. at the elementary level. It appears unlikely, even allowing for elementary school science specialists, that the available pool of teachers in the United States would be able to staff such a program were it to be instituted in this country.

The situation with respect to science curricula and science teachers might be considerably worse today were it not for the development of national curricula and the support of in-service workshops funded by the National Science Foundation over the past 25 years. It has been noted, for example, that "the study of evolution was a peripheral and neglected part of the biology curriculum prior to the development of the BSCS [Biological Sciences Curriculum Study] textbooks in the 1960s ... [Evolution's] importance continues to be reflected in many contemporary biology textbooks. Other textbooks, in a retreat from the 1960s, now have deemphasized evolution.... Word changes and deletions in the BSCS textbooks indicated sensitivity to pressure groups and increasing caution..."[6] This year (1981-82) it appears that the N.S.F. programs in science education are being virtually eliminated. It is difficult to see how the long-range consequences of this decision can fail to be harmful to our educational system.

Besides the problems special to science education, there are well-known general problems of schools and society which interfere with effective education. Quality education, as understood by the present authors, has not always been a high priority in our society, and educators outside of major universities are not generally accorded the esteem given to other professionals such as physicians, attorneys, or research scientists. This deters talented young scientists from serious involvement with education below the university level. The prevailing low salaries associated with this lack of esteem are an additional barrier, particularly in mathematics and science where other career

options are readily available. These factors account at least in part for the very small number of teachers graduating from secondary science programs in the past several years.

By now the general public is aware of the unfavorable learning environments which exist in many public schools, including widespread discipline problems which prevent large numbers of students from learning, and cause many dedicated teachers to fear for their safety or to leave the teaching profession suffering from "burnout." Massive educational bureaucracies, especially in large cities, are subject to the demands of state and local politics, and to the concerns of various interest groups. They are also constrained by far-reaching legal decisions. These factors surely contribute to the difficulty of implementing proposals for more effective educational programs.

Certain trends in society at large both reflect and contribute to our educational difficulties: the general increase in functional illiteracy among adults, for example, and declining scores on national standardized tests. Recent declines in economic productivity may reflect not only inadequate capital formation for investment in modern plants and equipment, but also inadequate investment in human resources through education and training.

Even more alarming is the tremendous increase in the prevalence of superstitious belief in the past decade. By this we do not mean "harmless" superstitions about black cats, spilling salt, breaking mirrors, or walking under ladders. We refer rather to world views based on the denial of scientific knowledge and the wholesale adoption of

belief systems in which demons, psychics or astrological influences hold sway.[7] These systems appear to be of two types: those which are explicitly anti-science [such as witchcraft, demonism, and astrology], and those which claim the status of alternate scientific theories, positing mysterious forces or undiscovered laws to "explain" unusual or occult phenomena [such as psychism, pyramid power, the Bermuda triangle, or Laetrile therapy]. In the latter category must also be included the "creationist" movement, which poses the Biblical account of divine creation as a "scientific theory" rivaling the theory of evolution.

We can only speculate on the reasons for the increase of superstitious belief in a technological age. It may have to do with a need to escape from the unpleasant effects of technology, or to deny the capability of scientists whose knowledge is inaccessible to the lay person. It may simply be the sense of comfort, reassurance or hope provided by some of these belief systems, or the promise of new horizons or exciting possibilities that they seem to open.

In any case, we may note some possible consequences of this trend. In the present generation, many people were "converted" to occultism or superstition by a combination of inadequate education, opportunistic media publicity, and psychological and social factors. In the next generation, there will be a substantial number who have grown up assimilating the world views of their parents, with fundamentally non-scientific outlooks developed from childhood. We also anticipate the emergence of substantial, well-funded, degree-granting institutions organized to promote non-scientific beliefs, and a tendency for even

"respectable" institutions to succumb to the lure of grant money offered by promoters of the occult. These trends will increase the difficulties facing science education in the near future.

To sum up, we believe that science education with respect to the general populace is not coping, but is instead steadily losing ground to the information onslaught. Pressing matters of public policy, such as issues of energy, environmental policy, military appropriations, medical costs, etc. have overtaken the public's capability to reach informed decisions. As the information onslaught threatens to overwhelm even those best prepared to deal with it--scientists, business executives, government experts--the situation may be made immeasurably worse if an uninformed citizenry chooses leaders who promise solutions based on faulty information.

The above discouraging tendencies notwithstanding, this country has managed to produce very capable scientists in considerable numbers. These scientists could--and should--provide a powerful resource for improving some aspects of science education.

II. Some Proposals for Strengthening Science Education

The ideas in this section emerged from a number of discussions among the authors. Although they are in a rough and preliminary form, we hope that they will provoke thought and discussion among the concerned community and that some of them, at least, will lead to the development of specific proposals for action.

A. Suggestions for Broadly Based Responses

It is clear that the numerous problems faced by science education require responses at local, state, and national levels. At the local level, an important priority should be to alter the way in which public school science teachers are regarded by the general public, and to increase the importance attached to public school science education. We feel that science teachers should be considered to some degree scientists as well as educators, and should have the prospect of achieving status within the community comparable to that enjoyed by university level teachers and research scientists. Such an improvement in the status of science teachers could attract more of those with greater scientific talent to the field of public education, helping to solve the problems cited earlier of the lack of younger science teachers, science teachers who are out of touch with scientific developments, etc. The need for improved status is especially acute at the elementary school level, where talented science specialists can make an enormous difference in instruction.

In order to improve the status of science teachers, it is clear that school administrators, teachers' organizations, and parents' associations all have roles to play. We direct our suggestions, however, to ways in which scientists at research institutions and universities can help. We recommend the following:

(1) Affiliations should be established with industrial and government research laboratories, and with universities, for public school science teachers who have demonstrated significant achievements and capabilities. These should be collegial affiliations with research science departments, offering science teachers the opportunity to interact with and benefit from contact with research scientists, and offering scientists the opportunity to learn about and influence the educational process.

There should also be reciprocal institutional relationships between public schools and research institutions, including for example talks at universities and laboratories by public school teachers, talks in public schools by practicing scientists to students, and student visits to research institutions for career planning and supplemental course work. Incentives for these activities must be provided by the employing institutions of both the scientists and the teachers. Where funds are short, incentives can take the form of public recognition through appropriate awards. A goal of these activities should be the development of a recognized sub-population of science teachers who are motivated to become and remain scientific as well as educational experts, and who are recognized in their communities and by their supervisors by virtue of their collegial affiliations with research institutions.

For these ideas to succeed on a broad front, it is important that affiliations not be limited to local "elite" schools which may neighbor research institutions and principally serve the children of university faculty or research professionals. The programs should rather be directed toward broad geographical areas, including major regions of cities, small rural townships, etc., so that in most public schools where there may be science teachers who want to participate, the opportunities to do so will be there.

(ii) At the state level, we believe that the direction of changes in teacher educational programs should be reversed, to emphasize the strengthening of competence in subject area content. The responsibility for such a change should be borne by the subject area departments in teacher preparation institutions, as well as by the departments or schools of education. Political voices are needed from scientists and citizens at the state level to influence certification boards in this direction. Likewise, in-service courses for classroom teachers should be oriented to a greater extent toward modern developments in science subject areas.

We suggest that the science and mathematics faculties in colleges and universities include elementary and secondary education specialists, establishing when appropriate joint appointments with education colleges or departments. Thus elementary and secondary educators would be selected and evaluated by personnel committees composed of mathematicians and scientists as well as education specialists, and the former would play a greater role in preparing

the next generation of teachers. The goal is to achieve a situation where entering teachers (a) include some of the more scientifically talented students in science departments; (b) comprehend the importance of communicating an understanding of the basic theoretical ideas of modern science, including a concept of what a scientific theory is, how scientific theories are arrived at and tested, and how scientific knowledge is obtained in the major disciplines; and (c) tend to develop and maintain the kinds of collegial affiliations with scientists which we have described above.

(iii) Finally, at the national level, it is necessary that the disastrous cutbacks in in-service science teacher education and science curriculum development be reversed. We also support the idea of funding exemplary "centers of excellence" in public high schools and elementary schools. We envision these centers as models of excellent science instruction, in which modern curricula would be offered with modern laboratory facilities, science teachers would be affiliated with research institutions, and various ideas for improving science education could be implemented and tested. In order that such centers truly serve as models that could be imitated nationally, it is important that schools be selected for participation which contain reasonable socio-economic cross sections, and that there be no "population filters" for selection of the student body. Thus we do not envision such a center in a "magnet school" for science, but rather in a school serving a reasonably diverse local community. Centers should include elementary and middle schools as well as high schools.

B. Incentive Programs

We suggest the exploration on a pilot basis of two kinds of broad-based incentive programs to promote scientific literacy among students and greater skills among teachers.

1. Teacher incentives

The major scientific societies, perhaps in cooperation with the National Science Foundation or the Educational Testing Service, should provide an opportunity for elementary and secondary school teachers of science and mathematics to qualify by examination for an advanced certificate in mathematics or one or more of the scientific disciplines. The certificates should be awarded on the basis of a national examination which tests competency at an advanced level. Familiarity with teaching techniques in mathematics and science should be included, but should not be the main emphasis of the examination. A model for the development of these examinations might be borrowed from the actuarial societies, and success on a certain number of examinations should qualify the teacher for membership in a professional society consisting of those who have qualified: for example, a National Academy of Science Teachers. Local school districts which desired to demonstrate excellence in science teaching could encourage their faculty to attempt the examinations, and provide incentives for doing so.

2. Student incentives

The problem of providing achievement incentives for school children is one of the most longstanding and difficult problems facing the educational community, and there are no easy solutions. The climate

established in the home can be all-important. Nevertheless, we believe that a broadly-based science incentive program directed at the elementary school level could have a significant effect on individual children and on school priorities as well. Such a program would address some of the existing deficiencies in elementary science education.

A pilot program could include grades 4-8, again covering a geographical area embracing a broad socio-economic cross section. Through a system of science achievement tests in elementary biology, chemistry, physics, geology, and astronomy, children would be able to qualify for a small stipend, averaging perhaps $100 per year per child, but increasing from the lowest to the highest grades, and paid in frequent small installments over the course of the school year. Payments would be administered by participating schools.

We have several reasons for suggesting this procedure. While a child who receives a substantial prize all at once may lose it right away or spend it impetuously, small frequent payments would provide a continual reminder to students of the status and benefits that they have earned through participation. They also provide the opportunity for follow-up by schools to encourage individual students. Finally, there is an additional reward value for the child in the process of receiving a check from the school and taking it to the bank to cash it.

The tests themselves should be achievement tests, not aptitude tests, since their purpose would be to encourage science study and not to screen children for special talent. They should be addressed to a broad population, establishing a level of attainment accessible to a

substantial number of students if they work seriously. The content domain of the tests should be publicized widely, with lists of suggested readings or study guides provided. It is hoped that such a program would not only motivate individual children, but would influence the educational priorities of their schools.

The difficulty of the tests should be planned so that perhaps half of all school children in the pilot district are able to qualify for prizes. It is important that enough prizes be awarded so that average children can achieve them, not just the exceptionally gifted. If there are too few awards, the recipients might be perceived negatively by their peers, and this would work in a direction opposite to that intended.

An essential ingredient of such a pilot program must be a carefully designed method for its evaluation, so that the extent of its benefits could be measured with some degree of confidence.

III. Conclusion

In this paper we have outlined some features of the crisis in science education as it appears to us, and have made a number of suggestions for addressing the problem. Many of these suggestions have been advanced before, and some may not be as effective as we hope. However, the magnitude, the urgency, and the complexity of the problem are such that bold steps are needed in the immediate future.

NOTES

1. See, for example, T. P. Carpenter, M. K. Corbitt, H. S. Kepner, Jr., M. M. Lindquist, and R. E. Reys. "Results from the Second Mathematics Assessments of the National Assessment of Educational Progress." Reston, Va.: National Council of Teachers of Mathematics (1981)

2. S. L. Helgeson, P. E. Blosser, and R. W. Howe. "The Status of Pre-College Science, Mathematics and Social Studies." 1955-75, Vol. I, Science. Columbus, Ohio: ERIC Center (1977).

3. Information from a letter to Rep. Don Fuqua, Chairman of the Committee on Science and Tecnnology, from Bill Aldridge, Exec. Director, NSTA, May 7, 1981; cited in ISTA Spectrum (Newsletter of the Illinois Science Teacher's Association), Vol. 7, October 1981, p. 25.

4. One of the present authors (G.G.) has observed this process closely as Coordinator of Mathematics Education (1971-77) at the University of Pennsylvania, and as Coordinator of Science Education (1978-present) at Northern Illinois University.

5. See, Guidelines and Standards for the Education of Secondary School Teachers of Science and Mathematics. Washington, D.C.: American Association for the Advancement of Science (1971).

6. G. Skoog. The Topic of Evolution in Secondary School Biology Textbooks: 1900-1977. Science Education 63, No. 5 (1979), pp. 621-640.

7. A continuing review of these developments is provided by The Skeptical Inquirer, published by the Committee for the Scientific Investigation of Claims of the Paranormal, Buffalo, N.Y. See especially B. Singer and V. A. Benassi, "Fooling Some of the People All of the Time," The Skeptical Inquirer Vol. V, Winter 1980-81, pp. 17-24.

Senator DOMENICI. Our next witness, then, will be Dr. Dacey, who heads Sandia Corp.

Before you testify, may I say to you how pleased I am that you were able to come. I think one of the most exemplary labs in the country is yours. I also am convinced that the way the Bell System prepared its executives for this nonprofit corporation is absolutely amazing. You came back to us after many years and were able to step right in and run one of the most difficult labs in all of the world.

I might say to you all, Dr. Dacey was the head of Sandia for 1 month when a Senate committee came here to be briefed on the lab in about a 3- or 4-hour presentation.

Now, you may not know what goes on at Sandia but take it from me, it is pretty tough to explain it to five or six Senators, and in that instance, also the then-Secretary of Energy. In any event, he had been here about 1 month. I was fully prepared to apologize to the Senators as to why the head man was not doing the explaining and you would be absolutely amazed; he did the entire briefing on the labs himself.

You can proceed.

STATEMENT OF DR. GEORGE DACEY, DIRECTOR, SANDIA LABORATORIES

Dr. DACEY. Well, Pete, after those kind words, I am left almost speechless but as you know, I am never speechless, so I will proceed.

HISTORY OF SCIENCE AND MATH IN UNITED STATES

I would like to perhaps address my remarks to the need for this kind of legislation by telling you some of the perceptions that I have as to what has happened to science and engineering in our country in the past 20 years since I was here before, as you pointed out.

It is a kind of vicious circle and I would like to sort of start at the top of that circle and work my way down.

If you look at our industrial output, in several of our most important industries we are losing ground relative to the rest of the world. We all know about the Japanese consumer electronics and auto industries but lesser-known are perhaps many other industries such as musical instruments, optical instruments that the other countries of the world are taking over.

Our industrial base is at some risk. If you go back the next step below actual production, you are talking about research and development and there again, I think we are in rather deep trouble.

The percentage of our gross national product which we are spending on R&D is less than any of our competitive countries in the world if you eliminate that research which goes into military. We are not spending as much percentagewise as the other countries in R&D.

Furthermore, as has been said here already, if you look at the number of scientists and engineers who are available to stimulate this engineering, and let us go back one step from R&D into education, you find that our schools of higher learning are in rather difficult straits.

U.S. GRADUATE SCHOOLS FILLED WITH FOREIGNERS

One statistic that has not been mentioned but one which, I think, is of considerable concern, is the percentage of doctoral degree recipients who are foreign nationals. For example, in engineering in 1981, 49.9 percent of all people getting doctorate degrees in engineering were not Americans, but foreigners; 31.5 percent in math and surprisingly, 25.9 percent in that newest of all things where we think we lead, computer science.

So for some reason or another, our own citizens are not filling up our graduate schools. Our graduate schools, I think, are the best in the world but our own people are not filling them up.

Well, now, why? Well, you have to go one step back further in this vicious circle to our secondary schools and primary schools and there, I think, as has been mentioned several times already, may rest the real answer as to why the whole system is caught in this closed loop.

Our young people are not being taught either the rudiments of or respect for science and mathematics and therefore, it is not surprising that they do not choose this as a field and that they are not the people who are in the graduate schools.

Now, it takes a generation or so for that kind of thing to show up as a closed circle. I think we are now beginning to see the net result in our economy of our failure to insist on excellent education for our young people over the past 20 years.

It is therefore essential that, among many other things which we will need to do, that we start that cycle going again.

Now, I would like to make just one or two other remarks. It has been asked several times why is this the situation? And of course, no one knows for sure but I have my own opinions.

I believe that nations get, to some extent, what they deserve. If you do not pay your teachers, you will not have good teachers. If you do not have respect in the society at large for science and engineering, then the children will not be inspired that this is the thing that they ought to do.

I see a turn in that now. I think that people are frightened by our lack of competitive edge and by the recession and I think that in the very last couple of years we are beginning to see more interest in science and engineering as a career. I guess my final remark would be, this is a very complex problem with many different ingredients to it, I think it is essential that we work on all levels of the problem but in particular, that we get at the basic problems, which is the next generation of contributors to our economy in science and engineering.

In that sense, I want to say that I support this legislation absolutely wholeheartedly and anything we can do to help, we would be glad to do.

UTILIZE RETIRED SCIENTISTS AND MATHEMATICIANS

Senator DOMENICI. Thank you, George. Let me just make a comment there. When this legislation was being prepared, I wondered how we might utilize what must be a very large group of retired scientists who live in States like ours and are no longer with you or even with Signetics.

This bill does provide in that area where the local school district would be building its enhancement with the money that they would get direct that one of the qualifying ways would be to create a corps of retired scientists and mathematicians who would then work with the particular school much the way we have the very, very successful retired executives helping small business.

I would think that if we could get something like that going as part of an ongoing process, it might be one of the quick ways to fill a gap, definitely not a solution but one of the ways to utilize some rather fantastic resource.

Let us now proceed with our next witness, Dr. Justiz, the Director of the National Institute for Education.

Dr. Justiz, we welcome you.

STATEMENT OF DR. MANUEL JUSTIZ, DIRECTOR, NATIONAL INSTITUTE OF EDUCATION

APPRECIATES SUPPORT

Dr. JUSTIZ. Thank you, Senator. Let me thank you first of all, Senator, for the strong support you gave to me during my Senate confirmation hearings. It is largely because of you that I am appearing before you today as the Director of the National Institute of Education.

I thank you for that support and I thank you for the opportunity to discuss with you an area that all of us are deeply concerned about and that is, the shortage of math and science teachers in this country.

I would like to focus my remarks in two parts. The first part, to talk a little bit about some international comparisons and the second part, to share with you some rather alarming figures about the shortage of math and science teachers.

UNILATERAL ECONOMIC DISARMAMENT

Mr. Chairman, it has become apparent that technology is changing the structure of the world economy and our ability as a country to maintain leadership, both in terms of providing for the defense of the free world as well as our ability to compete in the world markets and to sustain a strong and sound economy will depend largely on our ability to continue to maintain the technological leadership of the world.

If we do not keep up in industry as well as in the classroom, it will be as Nobel prize winner Glen Seaburg noted, unilateral economic disarmament.

UNITED STATES AND FOREIGN COMPARISONS

International comparisons show that we do more poorly on standardized tests than any other industrialized nation in the world.

In the Soviet Union, for instance, all students take algebra, 5 years of physics, and 4 years of chemistry before they complete high school. In the United States, on the other hand, only about half of America's graduating high school seniors take algebra and less than half take 1 year of chemistry and less than one-fifth take 1 year of physics.

All of Russia's high school students, before they graduate, will have taken calculus. In the United States, however, less than 37 percent of our graduating seniors have taken calculus.

Only one-third of our 17,000 school districts require more than 1 year of math or science to graduate and 7 States have no math or science requirement in order for a student to graduate.

Senator DOMENICI. None?

Dr. JUSTIZ. None, in seven States of the Union. Students in Japan, in Germany, and the U.S.S.R. undertake a far more rigorous program of studies in mathematics and science than our students do in this country and I think, given the competitive nature of the world economy and the significance of technology to the leadership that this country provides in the world, these are alarming figures.

Let me shift now to another part very closely related to this and that is the shortage of math and science teachers.

SCIENCE AND MATH TEACHER STATISTICS

Our Nation's ability to address this situation, to train an adequate pool of scientists and engineers to enter laboratories such as Los Alamos Labs and Sandia Labs in this State will depend largely

on our ability to have capable, well-trained teachers in our schools who can provide the necessary leadership in instruction in mathematics and sciences.

Again, there are some alarming figures in terms of teacher shortages. There has been a significant reduction, Senator, in the number of teachers trained in this country in the math and science fields.

Let me share some figures with you. Between 1970 and 1980, the number of prepared secondary mathematics teachers has declined by 77 percent. The decline among secondary science teachers was 65 percent.

A 1980 survey of States indicated that 43 of the 45 reporting States had shortages of secondary math teachers. A similar survey conducted in 1982 showed that in the area of physics, 42 States had a deficiency in the number of physics teachers and 27 had a critical shortage of physics teachers at the secondary level.

Significant shortages were also reported in chemistry in 38 States.

Another factor related to the shortage of math and science teachers has been a significant reduction in the number of trained teachers who were entering the teaching profession. In 1971, for every 100 science teachers, 59 percent went into teaching at the secondary level. By 1980, less than 54 percent were entering the world of teaching.

We are also learning that teachers, particularly the younger ones, are going into the teaching profession, the mathematics and science fields but do not stay in the profession very long. During the last year, we have received reports that more than 30 percent of all math and science teachers have left or are planning to leave the teaching profession to enter careers in business and industry.

The message, Senator, is clear. The critical shortage of teachers in math and science is significant and will continue to become an increasingly major problem in this country for the years to come.

I applaud your leadership, Senator, in establishing this hearing because I think that hearings such as this one provide an opportunity to increase awareness at the local level and to begin discussion on the significance of this very serious problem that faces our country.

I appreciate the opportunity to appear before you today and share these figures with you and will look forward to answering any questions that you may have, Senator.

Thank you.

Senator DOMENICI. Well, thank you very much.

[Dr. Justiz' full prepared statement follows:]

Dr. Manuel J. Justiz
Director, National Institute of Education

Mr. Chairman:

I am deeply honored to appear before the Senate Budget Committee today to discuss the importance and significance of math and science education to our Nation's future economic prosperity. I applaud the Committee's concern and the Chairman's efforts to begin a dialogue on the need to improve the quality of math and science education in our nation's schools.

I appear before you today as the Director of the National Institute of Education, the primary agency within the U.S. Department of Education that serves as a model for the Federal support of education through scientific inquiry, research and the dissemination of findings on critical issues facing education.

In this capacity I would like to provide this Committee with an educational perspective on the need for improved math and science education. Further, I would like to focus my remarks on the immediate and critical problem of the teacher shortage in science and mathematics, what we know about this problem and what we should be looking at through research to improve teaching and student achievement in these areas. We all have a stake in seeing that high quality education is available to all of our children and in working to ensure that our educational institutions produce the best for our nation. The quality of our education today will determine the quality of America's leaders tomorrow.

Our economic competitors in Japan and Europe clearly view national investments in education and training as integral parts of their broader economic strategies. That is, they understand that the success of their economic plans depend in no small measure on the technical competence of their population. Many of these nations are now taking the steps necessary to develop a technologically literate population and to integrate technology into the educational process. France has designed a plan to move technology into the classroom and to install computers in all high schools. England is developing a network of regional centers in educational computing and is developing a strategy for the large-scale installation of computers in their classes. The Soviet Union has already integrated computing into the curriculum and every child interacts with computers by eighth grade level.

The shortage of qualified science and mathematics teachers is well known and of great national concern particularly given the rapid acceleration in the use of science and mathematics in business and industry and the fact that these shortages have grown to be of near crisis proportions. New technology has extended scientific applications and altered the perception of these disciplines in the boardrooms of our largest and most well known corporations. Unless our nation is able to improve the teaching of science and mathematics, and teaching competency in these areas, the impact on our economy and society at large will be a misfortune of significant proportions. As noted by Glen Seaborg, Nobel prize winner in chemistry, the impact of the current situation and its effects can be characterized as "unilateral economic disarmament."

What we mean when we say the condition of math and science education in this country is declining is, first and foremost, that the achievement of our students in these areas has declined.

Despite some more encouraging signs of improvement, the evidence indicates a well-defined downward trend in the achievement of most of our students in math and science.

- Math scores on the Scholastic Aptitude Tests have been on the decline for the past twenty years.
- A ten-year span of reports of the National Assessment of Educational Progress, funded by NIE, shows a steep decline in math competence and a steady drop in science achievement.
- Such other measurements as the American College Tests (ACT), the Comprehensive Tests of Basic Skills (CBTS), the Iowa Tests of Educational Development (ITED), and the Minnesota Scholastic Aptitude Test have also repeatedly shown declining annual average scores.

The evidence points to a growing gap between the science and mathematics achievement of our top students, who are doing about as well as they ever have, and the remaining majority of students.

Comparisons with student achievement and education programs internationally put this information in even bolder relief. As Senator Domenici noted when he introduced S.248, the National Math and Science Excellence in Education Act, "In an international comparative study, American 13-year-olds scored more poorly in a standardized test than children the same age from England, Japan, Belgium, Australia, France, Scotland and the Netherlands." Some clue to explain these relative standings may be found in the fact that students in those countries whose challenge to U.S. technological supremacy is most pressing -- Japan, Germany and the USSR -- undertake far more rigorous and comprehensive studies in science and math than do our American youth.

Each of these countries follows a national curriculum or mandates national instructional policies. This is not and cannot be our way in the United States, where local control of education is a fundamental principle and contributes immeasurably to the strength and diversity of our educational system. But whatever the method, we must acknowledge the educational practices of other countries for their effects in math and science preparation.

- In the Soviet Union, for example, where almost 100% of the students complete secondary school compared to 75% in this country, a national elementary and secondary curriculum requires that all students take algebra, 5 years of physics and four years of chemistry. Only about half of American graduating high school students take algebra, far less than half take even one year of chemistry, and less than a fifth take a year of physics. All Russian high school students take calculus, but only 37% of U.S. students do.

- Japan has a national guideline that math and science instruction must constitute one-fourth of the junior high school program. The three-year pre-college curriculum at secondary level includes three natural science courses and four math courses.

- By contrast, in the U.S. it is the unusual high school student who takes math or science courses after the 10th grade. Among high school graduates, only half have taken math in grades 11 or 12. Only 1/3 of our 17,000 school districts require more than one year of math or science to graduate. No math is required at all for graduation in seven states.

On the basis of the relatively meager knowledge we have about the relationship of teaching, curriculum, and learning, we cannot say for sure that these more rigorous school experiences account for higher achievement overseas. Nor can we say for sure what causes underlie the declining student

achievement in math and science in this country. Intuition and available studies, however, suggest that we take a number of circumstances into account: 1) the shortage of well qualified teachers of math and sciences; 2) high school graduation and college entrance requirements; and 3) the content and standards of school curricula.

Declining achievement and low enrollments in high school mathematics and science courses portend trouble in the decades ahead. As the number of high school graduates declines in the coming decade by about 15 percent, it will become increasingly difficult to assure an adequate pool of scientists and engineers available to meet the national demand. Of equal concern, our citizens may be unable to operate as productively as they might in our technology-based economy, and they will grow progressively less capable of functioning as a well-informed citizenry, at the very time when science and technology issues are at the forefront of public policy.

For the past decade, one of our country's paramount educational concerns was the "teacher glut." After the swell of the post-war baby boom rolled past the school-age, a surplus of teachers was available for the diminished needs of schools facing decline in both enrollments and local budgets. Teacher training institutions contracted, emphasis turned to inservice training, and college students were encouraged to consider other more promising career opportunities.

Suddenly then, it seems, today there is widespread acknowledgement of critical shortages of teachers and deeply-felt concern over the effects of those shortages on our children's education, our citizenry's competence for the modern world, and the country's productivity and competitive position in the international economy. Just what is it that we know about this problem?

We know the shortages are not uniformly distributed across the population of current or graduating teachers. They are concentrated in such areas as industrial arts, special education, and mathematics and science teachers. This profile is strikingly similar to that of the mid-1960's, when shortages existed in almost precisely these areas. It was that situation that led to the greatly expanded programs and support for teacher education in the late 1960's and early 1970's.

There is in fact some prospect of an even more general shortage in the teacher supply in the near future. Enrollments in postsecondary education programs have declined by almost 50 percent since 1972. The National Education Association predicts that even fewer graduates than the present 75 percent will actually take teaching jobs in coming years. And the National Center for Education Statistics has projected data to suggest that there may be a 15% shortfall in the overall supply of teachers as soon as 1985.

The shortage in math and science teachers can be traced to several elements. First, there has been a reduction in the number of such teachers trained.

- Between 1970 and 1980, the number of secondary mathematics teachers prepared declined by 77%; the decline among secondary science teachers was 65%.

- A 1980 survey of states indicated that 43 of the 45 states reporting had shortages of secondary math teachers. Indeed a two-year survey of college placement officers completed in 1980 found that 22% of the high school math teaching slots nationwide were unfilled.

- A survey of state science supervisors in 1982 revealed shortages of physics teachers in 42 states (27 "critically" short) and shortages of chemistry teachers in 38 states.

- This bleak picture is further strained by a simultaneous drop during 1971-80 in the proportion of graduating science and math teachers who actually enter teaching. In 1971, for example, for 100 science teachers graduating, 59 took teaching positions; by 1980, only a little more than a third as many science teachers graduated, and of them only 54% entered active teaching. The reductions both in absolute numbers graduating and in percentages taking teaching positions for math teachers are even more alarming.

Further, we believe that the shortages are not uniformly distributed across the nation. Some states are probably not so severely affected as these data suggest. Of course, others must of necessity be in even more profound difficulty.

A second reason for the shortage is that teachers, especially the newer ones, do not all stay with the profession once they have entered it. Younger teachers leave their field in proportionately greater numbers than their seniors; one in four of our younger teachers plans to leave teaching completely. One recent study showed that almost 30 percent of the experienced math and science teachers had left or were planning to leave for other employment. In fact, almost five times more teachers in those fields left the profession for other non-teaching jobs than left for retirement. Finally, as Secretary Bell pointed out last week before Joint Subcommittees of the House Education and Labor Committee, many states and localities are raising graduation requirements in science and math or university entrance requirements or both. As enrollments rise because of increased requirements, the demand for qualified math and science teachers will increase at an alarming rate.

There is, I regret to say, an abundance of additional data that could be cited along these lines. The message is clear: there is a critical shortage of teachers of math and science, and it will likely get worse.

Let me say something about what we know and where we need to know more rather quickly in the area of teacher shortages.

For nearly a century, teaching was a respected profession and teachers were admired members of the community. Today it is evident that teaching no longer enjoys the unalloyed prestige it once did. Whatever the causes of the change

in public attitude, teaching no longer attracts the most dedicated and qualified young people into its ranks. We know this, but we do not know for sure why.

Salaries and other financial incentives for attracting and maintaining a high quality workforce, especially for math and science teachers, is one of the most frequently voiced recommendations for responding to the shortage. In Great Britain, where a similar problem exists, a "Committee of Inquiry" has recommended that local authorities be given discretion to offer math and science teachers higher level appointments and additional allowances. In the States, some have suggested differential salaries among various teaching fields according to which those in short supply would receive higher pay, even to the point of salaries competitive with business and industry. There is an immediate appeal to such proposals, but there are some difficulties that would have to be resolved, including the enormous public resources that would be required and the competitive tensions that would be developed within the teaching profession. It is also not clear just how much financial incentives have to do with attracting teachers, or how they interact with other influential factors such as the opportunity to be of service, to work with youth, and the like. NIE will be sponsoring a study on this subject this year and next. We expect its findings to be of great benefit to legislators, school boards, and school administrators as they grapple with this problem over time.

In some states and districts, certification requirements are altered or waived to enlarge the supply of available teachers from pools of other teachers, trained persons in business and industry, and college students preparing for other fields. The success of this approach depends largely on whether well-qualified individuals respond to the opportunities opened up. A survey by the

National Science Teachers Association of 2,000 randomly chosen secondary school principals showed that 50% of the new math and science teachers were not qualified to teach in these fields but were brought in on emergency waivers because there was no one better qualified available. Clearly, alteration of certification standards must be done in a way that enables well-qualified prospective teachers to enter the profession. Other incentives will probably be needed to complement changes in certification in order to attract teachers adequate in quality as well as in numbers.

At this very moment, final preparations are being made for an NIE Conference on Teacher Shortage in Science and Mathematics, scheduled for February 8-10 in Washington, D.C. Our Improvement of Science and Mathematics Team, organized last year to help us address this serious problem, has asked representatives from local, state, and federal governments, and from business and industry, to join us in examining the current status, conception and solutions to present problems in teaching science and mathematics. I have great confidence that this conference and the future research that we shall support because of it will be of immense value to communities, school administrators, science and math educators, legislators and policymakers throughout the country.

In light of our recognition of the importance of local initiative, the realities of economic stringency, and the rapid pace of scientific and technological development, we must review and modify outmoded methods of designing and conducting research and take this opportunity to plan future research activities in which there is a full partnership between the Federal government, business/industrial organizations, universities, local schools, parents and the community.

Thank you, Mr. Chairman, for the opportunity to appear before you today. I shall be happy to respond to any questions.

Senator DOMENICI. Dr. MacPherson, we welcome you.

STATEMENT OF DR. ROBERT MacPHERSON, PLANT MANAGER, SIGNETICS CORP

Dr. MACPHERSON. Thank you very much for inviting me.

I represent a new industry in this State. Signetics is a manufacturer of integrated circuits and we have been here just about a year. Integrated circuits are components of electronic instruments—in particular computers—and we are, therefore, very intensive in math and science engineering people in the design and manufacture of these circuits.

We employ here a large number of engineers, a large number of computer science graduates, a few mathematicians. All of these, however, are math and science intensive.

LOCKED IN STRUGGLE WITH JAPANESE

As many of you know, this particular industry, integrated circuits, is locked in the struggle with the Japanese for the world market share. We have consistently lost, over the last few years, that market share or pieces of it.

However, the technology was basically originated here and most of the innovations still originate here. But the handwriting is on the wall, if we do not do something we will slide into second class status with respect to the Japanese.

The issues are, to my mind, technology, quality of product, and productivity. In particular, I believe that it takes all three. We cannot just have innovative products and no way of getting them to market.

We cannot just have quality products without innovation and we cannot have the other two without productivity.

So these three issues concern me greatly and I have been in this industry now since 1957, if I remember correctly, and there has continuously been a shortage of engineering people, science people to supply the technical needs of the integrated circuit business.

If we do not have this supply of engineers, we will not be able to sustain the industry in its growth patterns so I would just conclude by saying the legislation that you have authored will go a long way toward helping the situation and I think we need to follow it by many, many more of the same.

Senator DOMENICI. Thank you very much.

Now we have completed the first round of the first panel and let me just find out, where do we stand timewise in terms of how we plan this hearing?

All right, we are pretty well on schedule and we have plenty of time. Let me summarize what I heard.

The shortage is obvious in terms of qualified teachers. The level of competency of the graduates from the school systems is inferior to other countries and certainly objectively not what any of the four of you think it ought to be.

WHAT TO DO ABOUT PROBLEM

So the question is, why and what do we do about it?

I do not have any reluctance to tell you that I certainly do not have the whole answer. It is a very complicated thing. But I wonder if you would agree that a part of the solution at the education level is that we have to find a way to get more teachers that are proficient and want to stay on and I wonder if you would not all conclude right off that, aside from more incentive, that there is a financial involvement in this?

Let me give you an example. One of my daughters was thinking of becoming a math teacher and went to look at a college. For my own personal reasons I was not too comfortable because I was concerned about her with her becoming a mathematician. I did not think she was qualified at that time in her life to do it.

I found that she had to take almost exactly the same courses to be a certified math teacher as she did to come out with a B.S. in mathematics. It seems to me that if you look out at the marketplace, unless you have some yearning desire to be a teacher, that that is one of the answers. If you have a lot of jobs for mathematicians, I think it pays more than teachers get and yet it is pretty tough academically to get there.

I have attempted in this bill to provide some college scholarships which would hopefully carry with them a return back to the profession. I wonder if you have any other ideas as to what we do about that situation?

Am I correct or at least partially correct in what I have just concluded? What do we do about that?

NO ECONOMIC INCENTIVE TO BE MATH TEACHER

Dr. DACEY. Well, you are certainly correct, I think, Pete, in terms of the economic incentives. A person getting a bachelor's degree in engineering and mathematics or science today can get a salary of the order of $25,000 a year at start.

There are no teaching jobs for a person of that training at anything close to that. Therefore, for a person to choose to become a teacher, if they have these other kinds of offers staring them in the face, requires a kind of dedication that I think is very rare. It seems to me one of the things that this bill does address and that we must address is to not ask people to make an incredible financial sacrifice in order to teach.

This thing feeds on itself as well. If you look at universities, they have something like a 10-percent shortage in teaching the teachers. The people who would would go into the teaching university science and engineering go into industry as well.

I think we have to redress the whole value system that we place on teaching as a profession.

Senator DOMENICI. Does anyone else care to comment?

REVERSE ANTI-TECHNOLOGY OUTLOOK

Dr. THORN. Well, I support what Dr. Dacey said and also would like to add that I think that we have to increase the esteem in which science is held in this country, too. I think there has been sort of an antitechnology feeling growing in the United States where people no longer wish to go into science and that reflects in

teaching, the salaries we pay the teachers and just the students that want to go into the fields.

Senator DOMENICI. In a small way, this bill addresses that by establishing a series of very high-visibility scholarships. The selection process would be made with the concurrence of the Commissions on Excellence. The National Science Foundation will make the actual selection. Then the States would be required, in conjunction with their U.S. Senators and Representatives to ceremonially award those scholars and thus lift the visibility of the competition.

We will certainly ask some experts. I think the theme is right. We will ask some people if maybe at the beginning there ought to be more rather than less of those actual scholarships. They tend to be minimized after a few years if they are too limited because the students begin to understand that it is a rather outrageous competition. There are 3,000 for one and we will certainly take a look at that.

The other is to send a little bit of money to every school district for them to do innovative things, including promoting the sensitivity of science and enhancing their own curriculum.

I do not know how else to do the latter, $200 million is not a lot but I personally made a decision and it will find its way through the committee, that that ought to go right down to each school district, even though it may not be a large amount of money.

But I will be interested in the educators that follow this and give us some notion of whether they think there is a better way to do that.

ADMINISTRATION TO PUSH FOR SCIENCE AND MATH TEACHERS

My last question: Dr. Justiz, are you aware of—and I really do not know if you are or not at this point, it is rather early—what is in the President's budget with reference to the areas we have discussed here today?

Dr. JUSTIZ. I am not certain, Senator. I believe that a request is being made for support through the National Science Foundation in the area of math and science.

Secretary Bell is presenting the administration's bill the early part of this week and the direction of the Secretary's proposal will be to find a way of getting as many qualified math and science teachers in the field as quickly as possible because of his awareness and recognition of the critical shortage that we are experiencing.

Senator DOMENICI. All right.

Senator BINGAMAN.

INTERN PROGRAM FOR STUDENTS WITH APTITUDE

Senator BINGAMAN. I wanted to ask, first of all, for Dr. Thorn and Dr. Dacey, if they would just comment as to, and I think Dr. Thorn addressed this somewhat, perhaps, in his comments, what role you think national laboratories can play in stimulating interest through some type of internship program for students who have shown some aptitude for science and math to actually get them exposed to some of these scientific activities that are taking place?

I think that is—I am really trying to talk more, I guess, about ways to improve our situation here in New Mexico but we have this tremendous resource of the national laboratories here.

Is there something that is being done there or can be done?

Dr. THORN. Well, I would like to just add to the remarks already made in that we do have the, what we call our "outreach program" where we are reaching out to the students in the northern New Mexico Counties. In addition to that, we have a specialized training program, skills training and employment programs, postdoctoral programs, summer graduate school programs. I think the National Laboratories are excellent places for teaching people because of the many facilities that are unique to them and to the cadre of very well-trained people who work in them.

So I think that it is just a national resource for training people.

Senator BINGAMAN. Dr. Dacey?

Dr. DACEY. Yes, I would just add to what Bob says, I believe that we have very similar programs to those at Los Alamos, including visiting schools programs to let them see what working scientists do and outreach programs of various kinds, visiting professor programs from the universities and visiting teaching appointments from Sandia to the university.

And all of those I think are good. I would point out, however, that they tend to reach the student after the student's interest in science and engineering has already been captured in one way or another and one of the problems I think is to try to capture people earlier than that and try to let the people know that there is something good out there to be had.

UTILIZING RETIRED PROFESSIONALS GOOD IDEA

I was struck by one of the things in the bill is to try to get retired and other business people to contribute in the school system. I do not think that daily teaching is necessarily very useful but on the other hand, sharing with students at a time when they can be influenced, the challenge and the excitement of science and engineering as a career might turn a few more heads in that direction and I think that is essentially what a big piece of the problem is, that many of our brightest young people are going into other fields.

PAC MAN SPURS INTEREST IN SCIENCE

Senator BINGAMAN. Let me just ask one other question then. It strikes me that these comments that Dr. Thorn made about general lack of respect for science as a pursuit here in the country, I do not really detect that. But it strikes me that with all of the emphasis that we see today on computers and on all kinds of video games and everything for youth, if there has ever been a time that people should have a natural attraction, youth should have a natural attraction for things scientific, I would think this should be it.

I do not know what can be done to build on that but it seems like someone who spends the first three years of their school time in a video arcade ought to be able to do something with that at some stage.

Do you think there is a bridge there? Do you think that at least the appreciation for the wonders of science can be built upon to get

more and more students interested in pursuing careers today than we could have, say, 10 years ago?

Dr. THORN. Well, I think that that video game, after the kid has played with that awhile and then he can turn to someone who tells him how the thing works inside excites his interest there. That is what is needed.

Senator BINGAMAN. Should we have courses in school that teach him how video games operate?

Dr. THORN. Or the basic principles underlying how the video games work, as well as many other scientific pieces of technology.

COLLEGE-LEVEL INCENTIVES ALSO NEEDED

Senator DOMENICI. Let me follow up with a private sector witness. First, I know that all four of you, and many that follow, know that bridging the deficiency gap is not going to take place only by increasing our proficiency in junior high and high school graduates, however you do that.

I mean, there is a critical shortage in the engineering and professional schools and science schools I did not intend to address that at all today, although I am inclined by some very reputable people to add a post-doctoral provision for postdoctorate students, that kind of short post-doc period when they are really neither fish nor fowl, and we would like to keep them in basic research. I am inclined to think of that and that came from the industrial people who said that "We can't use them yet and we really want them to stay in universities and other places for awhile longer," so we may add a fourth section, although that would really be after high school.

I am aware of that. I am aware that 50 percent of the graduates with doctor's degrees are foreigners. Obviously, that is symptomatic of some very serious problems but I would tell you that in the national budget now, in that area, the fastest-growing domestic program is research and development.

NSF and related matters are going to get an 18-percent increase at minimum. I am excited about that and I think that we owe it to Dr. Keyworth, who really got the President's ear.

I am not so excited after I look at the first year, Jeff, because the 18-percent increase does not continue. But maybe we can make it continue. It goes a little flat after 18 percent.

But there is another one that affects the two of you. There is a new $6 million for your post-doctorate programs, the ones where you have the very super fellowships. That is in and I am sure we are going to keep it. That came from the new Secretary of Energy. That should provide another nice category for those very talented young people that are not quite ready to go over and should not be going over to the Signetics and others.

WAYS PRIVATE SECTOR CAN HELP WITH PROBLEM

Now, Dr. MacPherson, the Administration has an indication that part of their program in this field will involve the private sector more than I have been able to figure it out in this bill. Do you have any ideas on how the private sector could be more utilized in the

enhancement of junior high and secondary education than we have discussed here today or that is included in this bill?

Dr. MACPHERSON. Well, we have addressed, really, the college-level student in trying to influence career direction and to enhance the exchange of information between students in our industry and professors in industry. We have not, at least in my industry, to my knowledge, done much in going below the college level.

It certainly is a recognized need. Starting earlier is always better. We are somewhat financially constrained for broad programs in trying to influence those areas.

I think that probably the best plan for us would be to influence the parents and the young adults that work for us to be active in the school programs, the local level school programs.

I detect a problem with financing of all education and in particular, science and math at the school board level. They do not have enough money to pay teachers for top talent so that they can compete with us and there seems to be a complete lack of interest in doing something about that, up to now.

Senator DOMENICI. I was thinking also in the equipment field.

Dr. MACPHERSON. Well, the equipment is—for our industry is rather peculiar. We have, in fact, donated equipment to universities. It is highly unlikely that the equipment would be interesting to schools that are of lower level than that, although that is not universally true.

Senator DOMENICI. It certainly would not be true in the computer area.

Dr. MACPHERSON. Computer areas? We are users as opposed to manufacturers.

Senator DOMENICI. I understand.

Dr. MACPHERSON. And we tend to have very large systems rather than things that are immediately useful to students in the school. So I think influence is where we can lean. That is, on parents.

Dr. DACEY. If I might make just one addition to that, Pete, 25 years ago, Bell Laboratories had a traveling exhibition called Mr. Magic, which some of you may have seen. It was supposed to take science to the schools, to the public schools and they had put together a whole lot of very beautiful little experiments which were fun and captured peoples' eyes. General Electric had a similar program. RCA had a similar program. I do not know why that has disappeared from the American scene but I think it was very effective.

I remember, many more years ago than that when I was in high school, seeing one of those things. Industry in those days seemed to be trying to get into the schools with little road shows. They were a little tricky, perhaps but they were fun and they did get kids thinking, gee, this is an interesting career.

Senator DOMENICI. Well, thank you very much.

Senator Bingaman.

Senator BINGAMAN. I have nothing further.

Senator DOMENICI. We appreciate your coming. Thank you very much.

[The first panel of witnesses is excused.]

Senator DOMENICI. If you will all please come forward?

Mr. Leonard Delayo, State superintendent of public instruction; Joe Romero, elected member of the State Board of Education; Dr. Jeanne Knight, director of elementary and secondary education, State Department of Education and Ms. Mary Beavis, president of the New Mexico Science Teachers Association.

Mr. Delayo, may I first, on behalf of my staff and the committee, thank you for your assistance, the constant communication with reference to this issue and this bill and your very valuable contributions. I look forward to your testimony. You may proceed first.

Mr. DELAYO. Thank you, Senator. You look a little bit older than you did when I was taking my practice teaching under Babe Parenti at St. Mary's High School a few years ago.

Senator DOMENICI. Yes. I won't comment on how much different you look. [Laughter and applause.]

Mr. DELAYO. I was told you would.

Senator DOMENICI. You asked for it and you got it.

STATEMENT OF LEONARD DELAYO, STATE SUPERINTENDENT OF PUBLIC INSTRUCTION, STATE OF NEW MEXICO

Mr. DELAYO. I shall open in keeping with my reputation, Mr. Chairman. I would like to begin on several controversial notes.

One, Senator Jennings, I think I agree with just about everything you said.

Senator JENNINGS. Of course.

INITIATIVE AND THRUST IN EDUCATION FROM STATES

Mr. DELAYO. And I think that might be a kind of a switch.

My colleague from Maine has said that the thrust of initiative should come from the Federal Government but must be administered by State education agencies to insure equity and excellence.

He was speaking, Senator Domenici, as a representative of the Council of Chief State School Officers, an organization that I belong to and an organization that I headed as president in 1972-73. I think his statement, if you please, borders on hypocrisy because, Mr. Chairman, we the State school officers of these United States, have been espousing for 20 years, 20 years that I have served in this capacity, that the initiative for education is a function of the States.

The industrial might and security of this Nation is being threatened and Mr. Chairman, we, including this chief State school officer, have been remiss in this regard.

We have permitted our young people, and I am concurring with Senator Jennings, to substitute courses like problems in American democracy, problems in family living and courses of that sort, we have permitted our young people.to substitute courses like these for math and science for too long.

The thrust should come from the States along with the Federal Government and the thrust should have come from the States in 1957, Senator, with the launching of Sputnik, if indeed, education is a function of the States as promulgated by our Founding Fathers.

I am here today to support this legislation and I trust that my experience with the 1958 Math and Science Institutes will be helpful in avoiding the pitfalls of that era.

This is where some long-time experience can be handy, Senator Bingaman.

Senator BINGAMAN. Are you implying that I have no long-time experience?

Mr. DELAYO. I am implying that as our chief executive, you are on the way, Senator. We all had to start some place.

PURPOSE OF AID SHOULD BE ENFORCED

I do not believe, and this may shock you and shock some of the people in the room, that aid should be granted to the States, to the local boards, businesses and so on, unless there is evidence that an effort is being made by the recipients to address the problem at hand.

I think we have a responsibility to move, not only because you are or you may provide us with some money, but I think we have a responsibility to move on our own as well as with whatever aid you might provide.

The effort of which I speak does not necessarily have to be a dollar one. There are approaches which can be made by States, local boards, or universities which hopefully will result in this Nation becoming more competitive with those countries which are outcompeting us, if you please.

The specific reference in your bill is the tax incentive concept, as stated.

PEOPLE OPPOSE STANDARDS

Now, New Mexico's proposals to address these problems are on record and available and it is not my purpose today to dwell on our plans. But tonight, in this very city, we are anticipating an audience of about 500 people who will come and challenge the proposed standards, particularly those in math and science that we will be advancing.

By the way, we started this movement just about a year ago.

We do have a plan, however, to increase our expectations of kids in math and science by specifying competencies and not by just adding the high school graduation requirements.

TEACHER MATH RENEWALS SHOULD BE REQUIRED

Now, elementary teachers, gentlemen, are instructors of science and math and should not be overlooked in this effort. Mathematical renewal efforts should be brought into the schools themselves as opposed to only returning to the universities for upgrading. This was the problem with the National Defense Act of Institutes of 1958, in my judgment.

They became graduate schools with emphasis on course credits. I am not denigrating in any way course credits but I think if there is to be a general upgrading, particularly in the elementary schools, then this renewal must indeed be brought to the schools.

I envision a plan whereby larger numbers of teachers could benefit by this legislation which, in turn, will impact a greater number of students.

Now, you clarified something for me a moment ago because as I read title III, section 5(C), you talk about volunteer help, Senator, and you make no mention in your legislation, although you just did, I think, about the possibility of paying to bring such help from the retired sector or from the labs into the individual schools of this State and of this Nation.

I trust I am not being presumptuous in this respect but as I read that section, it is not as clear, Senator, as you have made it and you have answered that question, so therefore, I shall not raise it.

This latitude, I think, is essential, if we are to avoid the pitfalls of the course credit syndrome.

NO CONGRESSIONAL STRINGS IN BILL HEARTENING

Now, Congress, pursuant to this legislation, does not become a super board of education for the Nation and I am pleased that I do not see the Federal strings which have been apparent in other laws which I have opposed.

If the guidelines established by the Department of Education place excessive controls with that bureaucracy regarding this legislation, then you and they will hear from me.

The final aspect of our review, although by no means the least important, is that section which addresses special populations and I believe, Senator, that should include women and I am tempted to ask the question of the Senator as to whether or not he discouraged his daughter from becoming a math teacher.

Senator DOMENICI. No. I will tell you this. That was a very particular and precise problem about her then physical and mental condition.

Mr. DELAYO. I understand.

Senator DOMENICI. That had nothing whatsoever to do with whether I wanted her to be a teacher. I wanted her to be. I found that——

Mr. DELAYO. I am being somewhat facetious, Senator. But you helped me make my point in that we have not looked upon the women of this Nation as potential math experts. They have been tossed aside in some respects by the men and I think we are losing out as a result of that.

I have a daughter who is particularly skilled in math and I would hope that perhaps you would keep that in mind as the guidelines are developed.

Senator DOMENICI. Well, just look at the legislation and it is there.

Mr. DELAYO. Thank you very much.

Senator DOMENICI. It says, along with some others, it says, "Native Americans, comma, and women."

Mr. DELAYO. I guess I missed that. Thank you for bringing that to my attention.

This concludes my comments. I have tried to stay within the time and perhaps I can be of some assistance in responding to questions, particularly the one raised by Senator Bingaman and later

on Senator Domenici as to how we might sustain an effort once an effort is started.

Thank you.

STATE PAYMENT FOR RETIREE EDUCATION ASSISTANCE

Senator DOMENICI. Let me first say, you are absolutely correct in your assumption. If the local school board, with the money that it gets to perform its local function in terms of excellence which would be established by the State board under the criteria developed, and that is purely State, if they chose to use some of their money in a program that took qualified volunteers that are already out there, retired scientists or those that are in the private sector that might want to do something because they already have a Ph.D., they are not precluded from making that a partial payment program and using part of that to pay for that kind of skill in whole or in part would be strictly up to them, as it is intended.

Mr. Joe Romero, State board of education. Mr. Romero, I am pleased that you were able to join us today and thank you very much for taking the time.

STATEMENT OF JOE ROMERO, ELECTED MEMBER, NEW MEXICO STATE BOARD OF EDUCATION

Mr. ROMERO. Chairman Domenici, Senator Bingaman, Senator Jennings, Representative Vigil.

My name is Joe Romero. I am from Espanola. And I am an elected member of the State board of education representing nine counties in northern New Mexico. I just concluded 10 years of service on the board, three of which I served as chairman. By way of introduction, the board is composed of 10 lay people who happen to be experts in the field of education.

I myself derive my livelihood selling insurance policies.

In New Mexico, the State board of education is the governing authority and has control, management, and gives direction to all public schools.

The severe shortage of qualified mathematics and science teachers is and has been a large concern to me. In preparation for this presentation I ran across the minutes of one of our board meetings of approximately a year ago and this is what I had to say then.

EXTRA PAY FOR MATH TEACHERS

Math and science education is dissolving as math and science teachers abandon our school systems in pursuit of better-paying industrial jobs. Many high schools throughout the country have no qualified math teachers on their staffs. Many States are in the process of paying an extra stipend to their math and science teachers and we should consider doing likewise here in New Mexico.

If we do not do something, then we should not be alarmed when we see Japan produce more than twice as many engineers per capita and that as a consequence, Japanese products are better-engineered than American products.

There are today 100,000 students in the United States taking calculus. There are five million students in the Soviet Union taking calculus.

Besides math and science, we face another crisis. We a mono-lingual nation dealing with a multilingual world.

And I used that as a pitch to go into bilingual education.

In New Mexico today we have 22 teachers teaching math with a waiver. Coincidentally, we have 22 teachers teaching science with a

waiver. That means that at least 22 districts of our 89 districts have at least one teacher with either a math or science waiver or both.

In my area, we have the good fortune that the Los Alamos National Laboratory has what is known as the educational outreach program. This program has the goal of sharing an awareness of current technology in science and engineering with northern New Mexican educators and students.

Through visits to the various schools, laboratory employees share accurate, scientific information, new concepts in technology and contacts for resource material with teachers so they in turn can provide this knowledge to the students.

Likewise, many other areas around the country are using different approaches to attack the problem.

STUDENT LOAN FORGIVENESS PROGRAM

In the State of Kentucky, they have created a student loan forgiveness program to attract future science and mathematics teachers. Other States have been reforming curricula, forming regional cooperatives to share such materials as computer software programs and creating summer institutes or workshops for instructors in math and science.

Many local districts are also taking whatever steps their budgets permit to meet this challenge. But the dimensions of the problem and the consequences for our national economy and national defense far transcend the capacities or the responsibilities of any one of our States or local districts.

This is a national problem. We must remember that in the area of trained personnel we are not only talking about the immediate needs of the schools. We are also talking about competing needs of business, of our national defense, both military and civilian.

It is essential, therefore, that we begin a substantial Federal investment in this area. We recognize that in light of current Federal budget restraints it is unrealistic to expect this investment which will eventually require billions of dollars to be forthcoming all at once.

But we can make a decent start this year at the Federal level.

I wish to commend you, Mr. Chairman, for the essential beginning represented by your measure. If enacted, and I say it must be, it can provide the kind of momentum necessary to start the whole country moving in the right direction and hopefully, lead to a larger Federal investment that will be needed to achieve the excellence that we can obtain.

Your immense store of expertise in the education area shows quite clearly in this bill. The measure covers almost every area of critical need related to science, mathematics, and computer training.

All the permissible funding areas available for fresh training for existing math and science teachers, congressional scholarships to help attract outstanding new teachers, the promotion of computer literacy, assistance in acquiring new equipment and many additional efforts are all essential.

In particular, I like the idea expressed in subparagraph 3 of title II where the State board of education has the duty to appoint the members of the advisory council.

We will involve the right kinds of people. We have done it before and we will do it again.

In New Mexico, I see an additional problem. Soon an attempt will be made to bring the State board of education and the State department of education under the purview of the office of the Governor. What bothers me most is that if the trend continues, these important offices will be staffed by folks from outside the state that know little about New Mexico and even less about New Mexico education.

But we will deal with that at a different time, with the proper fashion.

RECORD GOOD FOR MEETING NATIONAL NEEDS

Our State board and those around the country, and I think I can speak for them because I serve as a member of the board of directors of our national organization, are eager to do their part in this critical national effort, and I would remind you that the States which have the constitutional responsibility for education have a remarkable record in meeting national requirements.

During World War II under the National Emergency Production Act, State departments of education received more than $300 million from Washington, a far larger sum in those days, to train workers for defense-related industries.

Between 1940 and 1945, this emergency action produced an astonishing 7.5 million skilled workers. After the Sputnik shock, the United States, through its Department of Education, embarked on a highly successful program to upgrade human skills programs such as the National Defense Education Act which led to improvements in science education, language skills, and basic literacy.

Unfortunately, we reached the moon first and most of the education and training programs were abandoned.

Mr. Chairman, I want to thank you for the opportunity to testify before you. And I know that the State boards of education stand ready to work with you and your staff, especially Jan Lilja and Joe Trujillo, on the measure that is so essential for the strength of our national economy and our national defense.

Senator DOMENICI. Thank you very much.

Dr. Knight, we would like to hear from you.

STATEMENT OF DR. JEANNE KNIGHT, DIRECTOR, ELEMENTARY EDUCATION, NEW MEXICO STATE DEPARTMENT OF EDUCATION

Dr. KNIGHT. Senator Domenici, Senator Bingaman, Senator Jennings, and Representative Vigil, I would like to begin my comments by referring to a recent effort of the National Science Board.

FINDINGS OF THE NATIONAL SCIENCE BOARD

This group recently established a commission on precollege education in mathematics, science and technology, for the purpose of defining a national agenda for improving mathematics and science education in this country.

The first formal report of the commission outlined three equally important goals for the formal and informal education systems of the Nation. Slightly paraphrased, these goals are, first, to continue to develop and broaden the pool of students who are well prepared and motivated for advanced careers in math, science and engineering.

Second, would be to widen the range of high-quality educational offerings in mathematics, to try to encourage more students to go into technically oriented careers.

And the third goal is to increase the general mathematical, scientific, and technological literacy of all citizens who are alive to work in full participation in the society of the future.

The proposed legislation which we are reviewing here today would certainly enhance efforts to attain the goals outlined by this commission. I would agree that all three goals formulated by the commissioner are important but I would hope that our current efforts would place special emphasis on the third goal, that of increasing the mathematical and scientific literacy of the general population.

Failure to achieve this goal could jeopardize the accomplishment of the first two. Unless we reverse the trend of increasing apathy and distrust toward science and science education, future technological advancement could be thwarted in the voting booth. This has been alluded to earlier and I certainly agree with the gentleman's statement.

While the need for immediate improvements in the status of math and science education might lead to focusing more resources on high school programs, teachers and students, a recent report of the Joint Convocation of the National Academy of Science and the National Academy of Engineering suggests that long-term efforts to improve math and science instruction should include the elementary and middle schools.

According to this report, only half of all students like math by the end of third grade. That drops to less than one-fifth by the 12th grade. Almost one-half of all third graders dislike science. By the end of the 8th grade, only one-fifth have a positive attitude toward the subject and this fraction remains constant through high school.

When four-fifths of the student population enter high school with an acquired, and I emphasize acquired, an acquired dislike for math and science, achievement of any three of the Commission's goals becomes difficult indeed.

It is always popular for groups suggesting improvement in the field of education in any program area to address two issues which fall under the control of the educational community.

These two issues are, first, improved curriculum and, second, improved teacher preparation.

These suggested areas for improvement are not new to those of us who have been in the field of education since the late 1950's. We have the feeling of having been down this road before but we learned some things the last time down which could help us now.

The past experiences lead me to make some recommendations specific to two points in title III of the proposed Math and Science Excellence in Education Act. These points to which I refer would authorize funds, first to develop and upgrade curriculum and in-

structional materials and second, to support inservice training for current science and mathematics teachers.

SOURCE MATERIAL FOR DEVELOPING CURRICULUM AND INSTRUCTIONAL TOOLS

With regard to developing curriculum and instructional materials, I would urge those who will be involved to examine carefully the research reports describing the results of the science projects of the 1960's. The October, 1982 issue of Educational Leadership published a synthesis of the research emanating from these federally sponsored projects.

Researchers found that students in classes using these curricula outperformed students in traditional courses regardless of grade level, science discipline or student-teacher school characteristics.

Achievement scores improved across all grade levels, K through 12, as did attitudes toward science as a field of study.

Performance in process skills, problem-solving and critical thinking was improved at all grade levels and in addition, at the elementary level, student performance improved in the related skill areas of mathematics, reading, social studies and communication.

Why, then, do we have the problem that we are addressing today? Unfortunately, the projects were never implemented by more than 25 percent of the schools in the country.

While the projects of the 1960's probably should not be exhumed and readopted intact, the characteristics that contributed to their success should be reexamined and incorporated into future curriculum projects. The same statement is true about the inservice programs designed to assist in implementing the proposed upgraded curriculae and instructional materials.

FAILURE OF PROGRAMS DUE TO APPROPRIATE IN-SERVICE

That is, characteristics of effective inservice models should be identified and applied. Again, experiences from the past have taught us what some of these characteristics are and in my opinion, the reason that the projects to which I alluded earlier failed was the lack of appropriate inservice for the implementation of those programs into the schools.

Back to my notes. These experiences have taught us that the most consistent implementation of any desired curricular innovation occurs when all teachers in a school or department participate. This model encourages teachers to support one another in the new program and helps to insure that each teacher will build upon the skills and knowledges introduced at earlier levels. This is most often not true of science programs in the schools today.

Senator DOMENICI. Would you state that again, please?

Dr. KNIGHT. The type of inservice to which I allude encourages teachers to support one another and it helps to ensure that each teacher will build upon the skills and knowledges introduced at earlier levels.

Was that the point?

Senator DOMENICI. Yes.

Dr. KNIGHT. Thank you. The least effective inservice model, when departmentwide or schoolwide implementation is the desired

result, is that model which takes one teacher or Administrator through intensive training with the expectation that he or she will then "inservice the rest of the staff."

This model usually results in the desired program being implemented in one classroom only and receiving lip service, if any at all, in the other classrooms.

My final point concerning the upgrading of math and science education concerns administration. Again, experience has taught us that even when initial staff inservice is effective, the continued success of a program requires administrative support, supervision and followthrough.

While our standardized test scores in New Mexico do not always reflect the national trend in these areas, we recognize the need to improve. We also recognize that lasting improvement will require cooperation from colleges of education, from local education associations and agencies and the State department of education.

We feel, however, that this cooperation will occur because we finally have a goal upon which we all agree.

Thank you for this opportunity to address the panel.

Senator DOMENICI. Thank you for your most incisive testimony.

I do not think you knew, nor did our next witness know that I was a math teacher once, so I am a dropout.

Senator BINGAMAN. It is the good pay that brought you into this job, right?

Senator DOMENICI. Jeff, you did not have to say that. It was not the pay that caused me to change. At this stage I am not so sure that if I had stayed in education, I would not have been doing something in education that might have paid as much as being a Senator.

But without going into any detail, let me say that I think that your observations about all the teachers having to be somewhat on the same motivational wavelength is absolutely true. Since some around will know where I taught a long, long time ago, I do not want to go into too much detail but I can assure you that when I got to the fourth period in the morning and had a classroom of 37 and I could literally cut it right in half and half did not know how to add and half were ready for algebra. I did not receive any encouragement from the math teachers in that school to help the half that could not add.

To be honest with you, I did it anyway, but it was a pretty difficult job because I had one book to teach one group and one set of mimeographed papers to teach the other groups. But I borrowed a couple of smart kids who were good in algebra that did not need very much time on the side and they were great teachers. The only problem I had was that I could not have two classrooms, so that was not too easy. We had to have the one group that was learning algebra just button their ears while the others learned what they needed to learn. The real depressing thing was, nobody really thought I ought to be doing that and I think that may be what you are saying.

Dr. KNIGHT. Yes. Perhaps you should come and conduct some inservice.

Senator DOMENICI. Well, it is too far away now. I cannot even help my own with algebra now. They are already too smart.

We are delighted to have you here, Mary. I am sure you will give us some insights as you are the captain of the crew that does the work.

STATEMENT OF MARY H. BEAVIS, PRESIDENT, NEW MEXICO SCIENCE TEACHERS ASSOCIATION

Ms. BEAVIS. Thank you very much, Senator Domenici.

Senator Bingaman, panel members and ladies and gentlemen. I am here as spokesperson for the New Mexico Science Teachers Association, the Albuquerque Science Teachers Association, and as of this morning, the approximately 40,000 members of the National Science Teachers Association and its affiliates, all organizations composed of public and private school science educators, K through 12. We are the teachers.

As spokesperson, there are two areas of your bill that need to be singled out as very special, and they are the involvement of the National Science Foundation—we support this very strongly—and the inclusion of the elementary level, which is absolutely vital to the success of anything that is done at the secondary level.

We do support Senate Bill 248 totally.

THE CRISIS IN SCIENCE AND MATH EDUCATION

This legislation is sorely needed and is a beginning as we together face the problems that have come to be called "the crisis in science and math education."

This testimony, which is based on 16 years of science teaching and on personal experiences, reinforces the idea that those problems exist and have existed here in this State over that period of time.

In 1966, November of that year, after graduating from U.N.M. as a high school, well, as a junior high school science teacher, I applied for substitute work.

I was called the very next day and offered a permanent substitute position teaching 9th grade general science. I had always been told that there would be jobs for physical science teachers. I believed it then and I believe it now.

The first year of teaching is always a hard one, taking over in the middle of the semester is even worse. But I loved teaching and I loved challenges and I was qualified for that position.

A full year's contract was offered that spring. Three days before school started, my teaching assignment was changed from five classes of general science to teaching three of chemistry I, one of chemistry II and one of physics I.

Two teachers had resigned; one had gone to work with NASA and the other to accept a position in Central America.

Now, my teaching certificate said that I could teach chemistry and physics. I was certified. Qualified? I was not so sure. Added to that challenge was the knowledge that there are not many women physics teachers and that there was a need there, too.

That year was wonderful. But it pointed out the need for me to participate in further training which, at that time, was available through different grants and funds.

At the many professional meetings, there were exchanges of information, NSF Summer Institute materials were shared, involvement in choosing and even writing for textbooks, setting up models to use and evaluate, excitement at being a science teacher.

Motivation was high for us and consequently, motivation was high for our students.

As a tenured teacher, student and prestudent teachers were placed in the classroom with me. The interchange of new ideas, being able to guide them in the science of teaching, watching them develop as they worked with students, was exhilarating. And then, there were no more chemistry and physics students and prestudent teachers. They were in biology.

We complained rather bitterly to U.N.M., thinking that we were somehow being discriminated against but were told, "We would love to place them in all of the schools, Mary, but we do not have many any more and our policies are to place them at one or two schools in rotation."

VIETNAM INFLUENCED PRIORITIES

Society changed. The horrors of Vietnam influenced priorities and requirements at the university level and emphasis shifted regarding educational standards at the precollege levels, from what Sputnik had spawned to reflecting the volatility of what Vietnam was.

As department chairperson, I was called on to sit in on interviews with new hires and I began to see that most of the new blood were people like myself, women returning to the work force, transplanted new residents to Albuquerque, retired service personnel, older than the college graduates that we had been hiring. These people were and are experienced personnel with good, solid academic backgrounds and there was and is at this time excellent teaching going on in their classrooms. APS science scores continued going up and are consistently higher than the national norms. However, they are all going down.

This was and is an important source for science teachers but it is not sufficient. The question remains, who is going to take our places as we retire or as we move on to different challenges? There are many more who do this each year.

During those years, several excellent teachers left our department for other jobs in other fields and other States. California, Colorado. Recruitment from States already experiencing shortages had become active. Other fields where support was better, working conditions nicer, fewer nonteaching demands and, last, higher salaries took others.

We looked to the substitute rolls again and again to put teachers on full time depleting that source of potential science teachers. During all of this time, students' attitudes toward science and math courses were negative.

Reasons given included, "The course is too hard." "I do not need that for working in a construction job." "I do not want to lower my grade point average." And this is the one that still drives me straight up a wall, "Girls don't need science and math because you are just going to get married anyway."

Instead of motivation, frustration set in. My school was not the only one. There are 10 public high schools in this city and the same things are going on in them, too.

Throughout the State, from discussions with members of the State science education advisory committee and in my travels as president-elect of NMSTA, the very same questions and the very same concerns surfaced.

I am 1 of approximately 30 physical science teachers, part of 173 science teachers in this district. This district is one of 89 in the State and we are 1 of 50, plus the District of Columbia and the Commonwealth of Puerto Rico.

What has happened in my experience is not unique by any stretch of the imagination. NSTA's statistics and data draw the same appaliing conclusions for the entire country.

While APS has very excellent programs and workshops, both ongoing and beginning, support for them costs money. The state department of education and the State board of education are making many efforts also but, again, costs may prohibit progress and our State legislature has limited financial resources to work with.

CRISIS AFFECTS US ALL—STATE AND FEDERAL

We look to the Federal Government because this has to be a joint undertaking. The crisis affects us all. Cutbacks in all the arenas of our American life only add to the deepening crisis and we are fast losing our status as the No. 1 nation in the world.

My one concern is that our students, all of our students, be given the chance to keep us No. 1 and they will not be given that chance if we do not reorder our priorities and teach them what they need to know to function in the world of science and technology.

I respectfully request that my testimony be made part of the permanent field hearing report.

Thank you.

Senator DOMENICI. Thank you. It will be made a part of the record and I so much appreciate your testimony and your opening remarks in terms of the broad base of support. I hope that, as this bill and others wind their way through the U.S. Senate, that we will have an opportunity to call on you again to come and help there because, obviously, bills such as this have a way of getting changed and modified and molded and I certainly want to keep some of the premises that are in it.

PREPARED STATEMENT OF MARY H. BEAVIS, PRESIDENT, NEW MEXICO TEACHERS ASSOCIATION

Senator Domenici, Senator Bingaman, panel members, ladies and gentlemen, I am here as spokesperson for the New Mexico Science Teachers Association, the Albuquerque Science Teachers Association, and through Bill Aldridge, Executve Director, NSTA of the approximately 40,000 members of the National Science Teachers Association, and its affiliates, organizations composed of public and private school science educators, K-16. As spokesperson, there are two areas of your bill that need to be singled out as special. They are:

One, the improvement of the National Science Foundation—we strongly support this.

Two, the inclusion of the elementary level which is absolutely vital to the success of anything that is done at the secondary level.

NSTA has only one point of disagreement and that is roman numeral V, Part B of Title III. Grants to develop curricula at institutions of higher learning. Becuase of the large number of school districts and of institutions of higher learning, there is concern that funds could be used up "re-inventing the wheel." Otherwise, we support Senate Bill No. 248 totally. This legislation is sorely needed, and is a beginning as we together face the problems that have come to be called "The Crisis in Science and Math Education." These problems have been discussed at length elsewhere and were enumerated extremely well in your own Floor Statement to the Senate on January 3, 1983.

This testimony which is based on 16 years of science teaching, and personal experiences reinforces the idea these problems exist, and have existed here in this state over that period of time. In 1966 I graduated as a Jr. High School Science Teacher from UNM. In November of that year, I applied for substitute work and was called the very next day and offered a permanent substitute position at a 4 year High School, teaching 9th grade General Science. I had been told that "There would always be jobs for physical science teachers". I believed it then and I believe it now. The first year of teaching is always hard; taking over in the middle of a semester is worse; but I love challenges, and I was qualified for that position. A full year contract was offered that spring, and I worked all summer getting lesson plans, etc., done.

Three days before school started, my teaching assignment was changed from 5 General Science classes to 3 of Chemistry I, 1 of Chemistry II, and 1 of Physics I. Two teachers had resigned, one to go to work with NASA and the other to accept a position in Central America. My teaching certificate said I could teach Chemistry and Physics, I was certified; qualified, I wasn't so sure. Added to that challenge was the knowledge that there were not many women Physics teachers, and that there was a need there, too. That year was—wonderful. But it pointed out the need for me to participate in further training, which at that time was available through different grants and funds.

At the many professional meetings there were exchanges of information, NSF summer institute materials shared, involvement in choosing and even writing for textbooks, setting up models to use and evaluate, excitment in being a science teacher. Motivation was high for us and consequently motivation was high for our students.

As a tenured teacher student and pre-student teachers were placed in the classroom with me and the interchange of new ideas, being able to guide them in the science of teaching, watching them develop as they worked with students was exhilerating. Then—there were no more students in Chemistry and Physics. There were in Biology. We complained bitterly to UNM thinking we were being somehow discriminated against, but were told "We'd love to place them with all of the schools, but we don't have many anymore and our policies are to place them at 1 or 2 schools in rotation."

VIETNAM INFLUENCED PRIORITIES

Society changed, the horrors of Vietnam influenced priorities and requirements at the University levels, and emphasis shifted regarding educational standards at the pre-college levels from what Sputnik had spawned to reflecting the volatility of what Vietnam voiced.

As the years went by, I became Department Chairperson and was called on to sit in on interviews of the new hires. I began to see that most of the "new blood" were people like myself, women returning to the work force, transplanted new residents to Albuquerque, retired service personnel—older than the college graduates we had been hiring. These were and are experienced personnel with good solid academic backgrounds and there was, and is at this time, excellent teaching going on in their classrooms. APS Science test scores continued going up and are consistently higher than the National norms. This was and is an important source for science teachers but it is not sufficient. This question remains: Who is going to take our places as we retire or move on to different challenges? There are many more who do each year.

During those years, several excellent teachers left our Department for other jobs, in other fields, in other states. One took a teaching job in Californina, another went to Colorado. Recruitment from states already experiencing shortages became active. Other fields where support was better, working conditions nicer, fewer non-teaching demands and higher salaries took others. We looked to the substitute rolls again and again to put teachers on full time, depleting that source of potential science teachers. During all of this time students attitudes towards science and math

courses were negative. Reasons given included—"the course is too hard", "I don't need that for working construction", fear of lowering grade point averages, or, and this is the one that still drives me up a wall, "girls don't need science and math because you are going to just get married anyway." Instead of motivation, frustration set in.

My school was not the only one, there are 10 public high schools in this city and the same things were going on in them, too. Throughout the state, from discussions with members of the State Science Education Advisory Committee and in my travels as President-elect of NMSTA the same questions and concerns surfaced.

CRISIS AFFECTS US ALL

I am one of approximately 30 physical science teachers, part of 173 science teachers in the district; this district is one of 89 in the state, and we are one state in 50 (plus the District, Commonwealth, and territories.) What has happened in my own experiences is not unique by any stretch of the imagination. NSTA's statistics and data draw the same appalling conclusions for the entire country. While APS has excellent programs and workshops, both ongoing and beginning, support for them costs. The state Department of Education and State Board of Education are making efforts also, but, again, costs may prohibit progress. And our State Legislature has limited financial resourses to work with. We look to the Federal Government because this must be a joint undertaking. The crisis affects us all.

Cutbacks in all arenas of our American life only add to this deepening crisis and we are fast losing our status as the Number One Nation in the world. My one concern is that our students—all of our students—be given the chance to keep us Number One, and they won't be given that chance if we don't re-order our priorities, and teach them what they need to know to function in the world of science and technology.

I respectfully request that my testimony be made part of the permanent Field Hearing Report.

Thank you.

Senator DOMENICI. I have just a couple of questions. I am almost loathe to ask this one but I am going to, anyway.

STUDENT LOAN FORGIVENESS PROGRAM

A private sector group that looked at this bill gave me three or four suggestions. One I have already discussed, that we ought to add something for the post-doctorate scientists.

But another was that we ought to target some of our student aid programs. I just sort of looked at it and said, in my own mind, forget about it.

But somebody here today mentioned that perhaps there might be some consideration given to forgiveness for some of the student loan programs in exchange for work in this field, getting a degree in this field and teaching.

Now, that really does open a huge, huge area of discussion. But might I ask, nonetheless what you think about it?

What if we were to say, we really do not need any more than *x*-thousand math and science teachers over the next few years to catch up. Have the same national student loan guaranteed programs but if we were to say, if you do this and spend 1 year, for 1 year of teaching it, you do not have to pay your loans back. Would that have any effect?

Ms. BEAVIS. In the talks that I have had with teachers who have looked at this particular item of a forgiveness of loan, they seem to feel that it would be very important to draw very good people and people who might possibly have very much expertise in the possibility of becoming teachers but who would not look at it otherwise and so they are very supportive of the idea of a forgiveness loan.

LOAN FORGIVENESS USED BEFORE

Mr. DELAYO. I would support the concept. It has been done before, Senator. It was done with the title I teachers whose loans were forgiven if they taught in the disadvantaged schools. I think it works. I think it is worth a try.

Senator DOMENICI. Yes; we have something in the bill that permits something close to it but not as direct. The reason I said I am loathe to bring it up is not because I am frightened of it. I think it is an excellent idea. But I—you know, I am very much aware of where this student loan program has gone in the country. To hold it intact at its present level is going to be very difficult. This is not the only area that some are going to say we need more emphasis. I wonder where it would end.

But you say it was used for title I teachers?

Mr. DELAYO. Yes, it was. Forgiveness loans were used under title I. The teachers who taught in culturally and education-disadvantaged areas had their loans forgiven and the State attested to the fact that they actually did teach in those areas.

So the concept has been utilized by the Federal Government and in my judgment, it worked.

Senator DOMENICI. I have no further questions. I wanted to just make one observation for you, Mary. You talked about how you got your job. I want to tell you how I got mine, in the 1 year I taught.

I was certified to teach math and science in secondary schools but the only reason I got a job was because I volunteered to coach baseball free. So I do want you to know there are all kinds of reasons. I thought I was going to teach algebra and I ended up teaching something else.

STIGMA ATTACHED TO WOMEN SCIENCE AND MATH TEACHERS

Let me ask you one last question. Do you think, in the area of math and science that presently, as far as education and becoming a teacher, that there is any stigma, from the standpoint of women being involved?

I heard Mr. Delayo merely mention that the emphasis in our bill is toward women and other minority groups. But I just wonder what your feeling is?

Ms. BEAVIS. A stigma? To become a math teacher?

Senator DOMENICI. Well, no, would a woman be less apt to want to be one of these teachers for any reason that society has imposed or that laws or impressions have imposed. Do they consider it to be as appropriate for them as being a history teacher?

Ms. BEAVIS. I think more recently there has been much more emphasis on women being allowed into that field and becoming teachers and becoming very successful in those fields. We work very hard as teachers and role models, those of us who are in the field, to try and push this idea that those girls out there can go anywhere they want, can do anything they want. All they need is guidance and help.

Senator DOMENICI. Right.

Mr. DELAYO. When did you add "women" to this? The copy of my bill, Senator, excluded women and I thought I would just bring

that to your attention; consequently my comment in that respect. Let's keep the record accurate, Senator.

Senator DOMENICI. Let us keep the record straight. As we perfected this, that was added. Here is a copy for you and It has "women" in it.

Mr. DELAYO. I made my point. Thank you.

Senator DOMENICI. You did.

Ms. BEAVIS. Senator, we do have a network in New Mexico that works toward getting young women from grades 8 through 12 into math and science fields. It is called Women in Science and Engineering Network and we hold conferences all around the State. There will be one here in Albuquerque on the 26th of February.

We drew over 600 young women into that conference last year and that was only one of five, so we are working at it.

Senator DOMENICI. Senator Bingaman.

DOES EDUCATION UTILIZE CHILD INTEREST IN VIDEO GAMES

Senator BINGAMAN. I wanted to ask, and this is for anybody that would like to respond, do we, in fact, have courses in the elementary schools now which are designed to take the interest that the youth have in video games and all these things and actually stimulate that and take a few more steps?

I mean, is that something that our public educational system is building on or are we fighting that interest?

Dr. KNIGHT. Senator Bingaman, it is definitely encouraged at the State level. However, too often elementary science programs, where they exist at all, are simply reading about science rather than participating in science.

While there is a movement now to take advantage of the student interest in the video games, computer technology, it leaves a lot to be desired.

STATE SCIENCE FAIRS ACTIVE

Senator BINGAMAN. Let me ask about something that I used to attend when I was in high school. My dad was head of the Physical Sciences Department at New Mexico Western and he was a judge at science fairs, the State science fair that they had at Socorro each year. Do we still have as active a program of science fairs here in the State as we did at that time? And if so, what kind of support is given to that kind of activity and how important is it?

Ms. BEAVIS. We definitely have a great deal of support for that kind of activity. Science fairs in New Mexico are on the upswing whereas in many parts of the country they are on the downswing so we still have a good deal of support in the State.

We have our regional science fair that is held here in all of the regions. At the present time, our elementary schools are going through their own science fairs in Albuquerque. I can speak for that.

Maryann Esquibel, who is our science curriculum coordinator, has done an absolutely superb job at bringing up this idea of the elementary and junior high science fairs. We also have the State science fair still at Socorro, which is very well attended. And, this

year we will have the international science fair here in Albuquerque, in May.

Mr. DELAYO. We will bring students in from all over the world, Senators, to our State this spring to participate in the international science fair. I serve on that committee.

We are meeting tonight, by the way, in Las Lunas, to put the final pieces of it together.

Senator BINGAMAN. OK, that is encouraging. Let me follow up——

Senator DOMENICI. Jeff, could I just ask you to yield for a moment?

Senator BINGAMAN. Sure.

Senator DOMENICI. Jeff asked an interesting question for some of the lab leaders, and I do not know if they have gone yet. I have one I want to ask about Los Alamos, so is the Los Alamos man here?

Dr. THORN. Right here, Senator. I am still here.

Senator DOMENICI. All right, I am going to ask you something in a minute. In terms of this international fair, I think it wold be a logical question to follow on one of Senator Bingaman's.

Are we going to use some of the fantastic things that go on in our labs to further excite the extraodinary group that is coming from around this country and the rest of the world? Or are they just going to be here to show their own things? Will Sandia and Los Alamos help to further excite the 3,000 young people that are going to be here?

Mr. DELAYO. Do you want to hear from Los Alamos first?

Senator DOMENICI. Yes, sure.

Dr. THORN. We are hosting 200 of the young people at the laboratory.

Senator DOMENICI. Oh, that is great.

We would like to know about Sandia.

Mr. DELAYO. Affirmative. Sandia is participating and they have a representative on the statewide committee on which I serve, Senator.

Senator DOMENICI. Go ahead, Jeff.

LONG-TERM COMMITMENT NEEDED

Senator BINGAMAN. My last question was prompted by Leonard's comment that he had something to offer in the way of how we could sustain a commitment to science and math education if it once gets started. I would be interested in hearing what you have to say on that, or what any of the people on the panel have to say on that.

Mr. DELAYO. Senator, I do not have much to say, except tht my experience with Federal programs indicates, unfortunately, that once they are dropped, then the interest tends to drop. I think there is an unfortunate history in this respect.

That is the reason why, in my comments, I indicated that I think grants should not be made unless there is a commitment from the State. I meant a long-term commitment from the State, from the local, from the recipients of the scholarship and so on, right down the line and unless there is that, Senator Bingaman, I do not think the interest would be sustained.

Senator DOMENICI. Jeff, that raises, one of the tough problems regarding this legislation. If you note, this bill does not have any match and I am not suggesting that that be changed nor necessarily is he. However, sometimes our programs are, "We give you 50 cents. You put up 50 cents." It is 50–50. Some are 75–25.

I am sure there is going to be a proposal that requires a match. Although I am pleased to say that I understand the administration's proposal, while it might not be as broad, is a nonmatch program, in terms of direct support.

It seems to me that we ought to be expecting some kind of inkind commitment or we are just going to have what this requires and nothing else. I think that is what you are saying.

Mr. DELAYO. This is my point. I indicated clearly, not necessarily a dollar match but an interest match which could be a new concept and might bring about that which you are striving for, Senator Bingaman, sustaining the interest.

Senator DOMENICI. Do you have anything further, Senator?

Senator BINGAMAN. That is all I have.

Senator DOMENICI. Let me ask the Los Alamos representative: in the direct testimony previously, the Outreach program that Los Alamos has used to go out and sensitize and involve our young people, was categorized as being involved in northern New Mexico schools. Is that so?

Mr. ABAD E. SANDOVAL. Yes, Senator. I am the director of that program and what we have done is, we have taken the seven surrounding counties of Los Alamos, Los Alamos being one of the seven counties. If you look at that geographically, that is about equivalent to the same geographical area as three New England States. The lab is doing quite a bit.

Senator DOMENICI. Well, I am not arguing that. I am not asking that you expand it, I just want to make sure I know what it is. What are the counties?

Mr. SANDOVAL. Los Alamos, Mouras, Santa Fe, San Miguel, Taos, Rio Riva, and San Dimas.

Senator DOMENICI. Thank you very much.

I have no further questions. I am most appreciative of your coming here.

[The second panel of witnesses is excused.]

Mr. DELAYO. With the Chair's permission, I would like, Senator——

Senator DOMENICI. Please.

Mr. DELAYO [continuing].—For the record to indicate that math and science scores have been on the uprise here in New Mexico for 6 years and I wanted Mr. Justiz from the NIE to hear that.

Senator DOMENICI. Good.

Are we on time?

My staff tells me we are on schedule and so, before the next panel of witnesses comes up, we will take a 5-minute recess.

[Brief recess.]

Senator DOMENICI. For our third panel, we have one which consists of Dr. Joseph Scaletti, associate provost for research for the University of New Mexico; Dr. Richard Griego, University of New Mexico professor of mathematics, director of the Southwest Resource Center; Dr. Paul Resta, University of New Mexico, assistant

dean of the School of Education and president of the New Mexico Council of Computer Users in Education; Dr. Werner Muller, Highlands University professor of science education and Dr. Fred Begay, staff physicist, Los Alamos Scientific Labs.

We welcome you all. We will start in the order that I introduced you. Joseph, you may proceed.

Dr. SCALETTI. Thank you.

STATEMENT OF DR. JOSEPH V. SCALETTI, ASSOCIATE PROVOST FOR RESEARCH, UNIVERSITY OF NEW MEXICO

Mr. Chairman, I am very pleased to have this opportunity to appear before your committee to discuss the importance and significance of mathematics and science education to America's future economic prosperity.

As an educator and research administrator I am most pleased with the overall concepts that are embodied in this proposed legislation and the recognition by the Federal Government of a growing national crisis in sciences and mathematics education of our national youth.

The proposed legislation touches the cornerstone of the educational system in recognizing the importance of encouraging and enhancing science and mathematics education at the elementary, secondary and then postsecondary levels.

DATA SUPPORTING CRISIS WELL DOCUMENTED

The data in support of the crisis in science and math is well documented in the testimony before the Senate Commerce, Transportation, Science and Technology Subcommittee by Sarah Kline, president of the National Science Teachers Association and in the first formal report of the National Science Foundation Commission on Precollege Education in Mathematics, Science and Technology cochaired by William Coleman and Cecily Cannan Selby.

I will not bother to repeat those well-documented statistics of the crisis.

My comments today will emphasize the need for science and mathematics education as part of a continuum, a continuum through the university undergraduate, graduate, postgraduate curriculum as well as research.

UNIVERSITIES DEPEND ON PRODUCT OF PUBLIC SCHOOLS

As Dr. Dacey pointed out in an earlier testimony before this committee, it is a continuum that involves the industrial sectors, the graduate school sector, the undergraduate school sector. The legislation which proposes enhancement of science and math education at the elementary and secondary levels addresses this continuum concept. As members of the higher education community, our reason for being concerned, of course, is that the university depends on the product of our public schools. Based on the qualifications of those students, universities must do what we have to do relative to the quality of that product. Namely, if the product is well educated, well trained, we proceed from that point and add more to the students' formal education.

If it is not, we must back off and do some things along the lines of remedial education.

As you know, Senator, the statistics in this regard have increased rapidly in recent times in terms of students entering the universities having to take remedial work in math and sciences.

Secondly, the university is interested by virtue of the fact that shortly, students in the universities who continue on will soon be going out into the world's marketplace become part of the work force.

Few people would disagree with the comments of Charles Robb of Virginia, representing the National Governor's Association when he said, "The industrial world stands at the threshold," I quote,

> The industrial world stands at the threshold of technology revolution that will change the American way of life and the composition of the Nation's workforce as much as the indstrial revolution did a century ago.

Studies have estimated that in the past decade, approximately 75 percent of the net increases in manufacturing jobs could be attributed to industries in the high-technology fields and that technology revolution will contribute to the creation of substantially more new jobs in the next 10 years.

These estimates appear to be substantiated, as you properly pointed out in your introductory comments earlier, Mr. Chairman, by the Bureau of Labor Statistics in projecting a 40 percent increase in the demand for scientists and engineering professionals between the years 1978 and 1990 and these representing the disciplines of mathematics, physical sciences, life sciences and computer sciences.

TECHNOLOGICAL PROGRESS BASED ON ADEQUATELY EDUCATED PEOPLE

There is no question that the technological progress of the Nation is fundamentally based in adequately educated human resources in the sciences and mathematics.

I do agree with the comments of Thomas Vanderslice, president of GTE, that maintaining our technical prominence in the world depends on three sources, ample funding for research and development, modernization of research equipment and facilities, and a steady flow of well-educated, trained, creative minds.

The proposed legislation on excellence in science and math begins to address these factors. However, it will still be necessary for a continued and concerted effort, Senator Bingaman, on the part of the local government, State government, industry, educators and the public to continue to be alert to the basic educational needs and skills of our youth to meet the demands of a knowledge-intensive, high-technology world.

I might mention, Mr. Chairman, that the Legislature of the State of New Mexico has in recent years, recognized the importance of high technology and science and mathematics in appropriating legislation for a science-engineering equipment bond, a $25 million 5-year equipment program.

We are entering our fourth year of that, Senator Jennings, Representative Vigil. This points out the continued attention that must be given at all levels of our community, not just the Federal Government but State and local governments as well.

Mr. Chairman, I am pleased to support the proposed National Math and Science Excellence in Education Act of 1983 addressing science and math education merit scholarships and teaching awards, and the establishment of a Commission on Mathematics and Scientific Excellence which will continually review the status of math and science in education in this State and, hopefully, provide a continuation of our concerns and not let it die as a result of Federal resources.

And finally, the creation of block grants for the improvement of math and science education.

Thank you, Mr. Chairman.

Senator DOMENICI. Well, thank you very much, Dr. Scaletti.

Dr. Griego, we welcome you and we look forward to your testimony.

STATEMENT OF DR. RICHARD GRIEGO, PROFESSOR OF MATHEMATICS, UNIVERSITY OF NEW MEXICO, AND DIRECTOR, SOUTHWEST RESOURCE CENTER FOR SCIENCE AND ENGINEERING

Dr. GRIEGO. I am very pleased to be here with you this afternoon to talk about these issues of great importance. I have given a copy of my testimony to Mr. Trujillo who, by the way, took a class in mathematics with me some time ago. I will not say how long ago.

Senator DOMENICI. You do not want to tell me how he did, do you, Doctor?

Mr. GRIEGO. Well, he got an A. Actually, he was a very good student.

I would like to speak more informally and off the cuff, if I might, Senator?

Senator DOMENICI. Great. Your statement will be made a part of the record.

Mr. GRIEGO. Good.

TESTIMONY TO THE U.S. SENATE COMMITTEE ON THE BUDGET
REGARDING NATIONAL AND STATE NEEDS IN SCIENCE EDUCATION
PUBLIC HEARING

February 7, 1983
Albuquerque, New Mexico

by
Richard J. Griego
Director, Southwest Resource Center for Science and Engineering
and, Professor of Mathematics, University of New Mexico

INTRODUCTION

This meeting has been called due to the national concern regarding the shortfall of qualified mathematics and science teachers for the needs of our society and the general decline among our student population in mathematics and science participation and achievement. In this circle of issues, it is of great importance to stimulate participation on the part of underrepresented groups. Minority groups and women constitute vast pools of talent that are not being adequately tapped to help solve the problems we face today.

The Resource Center for Science and Engineering program of the National Science Foundation was initiated for the purpose of addressing, on a regional basis, the severe underrepresentation of minority and low-income groups in science and engineering. A total of four Resource Centers have been established to date. The first Resource Center was established in 1978 at Atlanta University to serve the Southeast. This was followed by the establishment in successive years of Resource Centers in New Mexico to serve the Southwest, in Puerto Rico to serve that island and in New York City to serve the Northeast. Each Resource Center

has a mandate to deal with a regional constituency on a broad basis. Programmatic activities span both precollege and university levels, including graduate school and postdoctoral levels.

The Southwest Resource Center for Science and Engineering is comprised of a network of ten cooperating colleges and universities in southern Colorado, New Mexico, the El Paso, Texas area and the Navajo Reservation in New Mexico and Arizona. Resource Center liaison personnel are placed at these schools and they serve their host institutions and public schools in their geographical area. The University of New Mexico is the fiscal agent for the Resource Center grant and houses the Director. Also, the university level programs of the Resource Center are administered by the University of New Mexico office. The Associate Director is located at New Mexico State University and that office administers the Center's precollege and liaison activities.

University level activities consist of research projects, student internships, postdoctoral fellowships, faculty internships, and summer workshops for public school teachers and counselors. The summer workshops for teachers/counselors are offered for university credit and are thus considered part of the university level activities of the Resource Center.

Since the purpose of this meeting is to discuss problems and solutions at the precollege level, I will elaborate on these aspects of the Southwest Resource Center in more detail along with the summer teacher/counselor workshops.

Before pursuing this elaboration however, it is useful to point out some of the unique advantages of the Resource Center structure.

The liaison network is a very important part of the structure of the Southwest Resource Center. Each liaison is responsible for involving his/her

local constituency in Resource Center activities that are carried out on a Center-wide basis. Moreover, each liaison is provided with limited funds for initiating local activities at the liaison's discretion. This combination of center-wide direction and local autonomy and discretion has proved to be very fruitful. Also, each liaison is free to pursue funding and support for activities at his/her institution. This has been successfully accomplished in a number of cases among our liaisons.

Another factor of importance in the Southwest Resource Center structure is the comprehensiveness of our activities. Our programs begin at the elementary school level and proceed on through middle and high school and on up to the university level, including graduate school and postdoctoral activities. The comprehensive nature of our activities (in terms of the differing levels that are served) allows for interaction between the various programmatic levels that maximize the effect of our efforts. For example, a Resource Center postdoctoral fellow can serve as a mentor for a high school student for a research apprenticeship or a science fair project. Or a research project for developing software for computer educational purposes at the middle school level can utilize a teacher who has been trained in a summer workshop. Once developed, the software can be distributed throughout the network and used in classroom demonstrations in our travelling science show.

This interaction between the various levels of the Resource Center's activities lends a cohesiveness to our efforts and gives us more effect for the dollar.

We recognize that the context offered by the Resource Center structure and mandate is not easily replicated in other circumstances. However, some of the lessons we have drawn from our comprehensive program may be of use to others.

DESCRIPTION OF PRECOLLEGE PROGRAMS

Center-Wide Activities

The Southwest Resource Center conducts a number of activities at the precollege level that involve all or most of the liaisons and their local public school constituencies. These are as follows:

a. S.I.S.E. Program. The Summer Institute for Science and Engineering is a program whereby forty tenth and eleventh grade minority and low-income students from the region spend three weeks in residence at New Mexico State University in Las Cruces, attending classes and workshops in a number of science and engineering fields. Typically, students study physics, computer science, chemistry, biology, electrical and civil engineering and technical writing. S.I.S.E. emphasizes learning concepts and problem-solving skills. Each student undertakes individualized projects, and some homework is required. Field trips to industries and scientific points of interest provide opportunities to observe practical applications of technology and to meet working scientists and engineers.

b. Microgrants. The Resource Center awards ten grants annually of $500 each to public school teachers for innovative projects in science related subjects. Hopefully, other teachers can use these projects as models for their own classes. The purchase of general purpose equipment is not covered under the microgrants program.

c. High School Apprenticeships. By means of auxillary funds, the Resource Center offers high school students research apprenticeships through the sponsorship of six of the network institutions. The students participate in research project activities under the supervision of university faculty members during the summer and engage in academic year follow-up activities.

d. Travelling Science Show. Regional public schools are served by our travelling science show. The show has four components: computer demonstrations, laser demonstrations, a portable planetarium (Starlab), and a chemistry magic show. These activities are most appropriate for elementary and middle school audiences.

e. Teacher/Counselor Summer Workshops. About 250 teachers and counselors from regional public schools have participated during the past three years in summer workshops that are offered for university credit. These workshops have included two workshops for elementary school teachers based on the LESSON curriculum developed by the Lawrence Livermore Laboratory, five separate workshops on the use of microcomputers in the classroom, an astronomy workshop covering the latest developments in cosmology, and a workshop to familiarize counselors with opportunities in the sciences and engineering. The workshops have been of from one to two weeks in duration. For the summer of 1983, we are planning another counselor workshop and a workshop in problem solving and mathematical modelling.

f. Conferences. The Resource Center sponsors or co-sponsors a variety of conferences and meetings. For example, the Resource Center has aided in conducting conferences on opportunities for women in the sciences, on equity in mathematics, and on computer use in the public schools. The Resource Center conducted a major conference in October of 1982 that was attended by 2,500 teachers, students (both public school and college), scientists and engineers, and the public at large.

g. Resources for Schools. The Resource Center makes its resource materials available to schools on a loan (no fee) basis. In this regard, the Resource Center has videocassettes, films, books and magazines, and computer software for loan to teachers and students.

Local Activities

In addition to the extensive list of programs and activities at the precollege level described above, the Resource Center liaisons conduct a number of other activities at their own discretion. Such activities are carried out by means of funds provided by the Resource Center central office and by means of funds raised by the liaisons themselves or in cooperation with others.

The wide variety of such discretionary programs is not able to be listed in this account due to shortage of space. However, it is worthwhile to point out two efforts that may have applicability in other contexts and that have proved to be significant and successful.

a. Saturday Science Academies. A number of liaisons have conducted their own versions of the Saturday Science Academy. The common feature of the Academy is that the program is directed at elementary school students during the academic year and is conducted during non-school hours. A typical Academy meets on Saturday mornings for eight to ten weeks with thirty to forty students enrolled. The approach used in the Saturday Science Academy is a hands-on method of learning and strengthening basic scientific concepts. The Academies are intended to let students experience mathematics and science as interesting and fun. No tests are given on the material presented during the Academy sessions, but homework is sometimes required. A typical curriculum offers classes in microcomputers and in laboratory sciences (chemistry, biology, and geology).

b. Science Fair Teams. The University of New Mexico office has organized a science fair team with seventeen high school students as members. The vast majority of the team members have never participated in science fairs before and the purpose of the project is to motivate and guide the team members in

developing a science fair project for competition. The participants meet regularly with mentors (usually UNM faculty) to plan and follow through on their research. The students learn scientific methodology, technical writing, and presentation skills. The Resource Center aids with the purchase of project materials and supplies.

Lessons Learned

What have we learned in the three and a half years of the Southwest Resource Center's existence?

Some of the lessons learned have to do with the particular structure and nature of the Resource Center program. Other lessons learned have more general relevance and applicability.

a. Effectiveness of Comprehensive Approaches. As pointed out before, one of the important features of the Resource Center has to do with the fact that we cover such a broad spectrum of levels and activities. The important point is that these separate activities at differing levels are not isolated from one another; they interact and reinforce and strengthen each other.

We are on the look out for the possibilities of such interaction and encourage it when possible. However, we do not artificially force interaction and cooperation where none exists naturally.

For example, an American Indian postdoctoral fellow supported by the Resource Center in turn served as a mentor for a high school apprentice and gave lectures in other science support activities. He also played an important part in our major conference by serving as a judge for the student poster session and by participating in career encounter sessions with students. He served as an important role model for American Indian students. Of course, the postdoctoral fellow himself benefited in his own research and intellectual development through his two year fellowship.

Another example is afforded by a research project that supported a couple of minority university computer science students. By means of the project, the students (under faculty supervision) developed software in conjunction with a middle school mathematics teacher who had been trained in one of our summer computer workshops. The teacher's classrooms in a predominantly low-income and minority school were used for testing the software and improving it. This software has been furnished to our liaisons and to teachers in our network. The software is also used in our travelling science show, conferences, and computer workshops. Based on the experience gained in this project and in our summer workshops, the UNM Department of Mathematics is instituting a course in microcomputers for teachers.

We have seen many instances whereby teacher and counselor participants in our summer workshops have also participated in other aspects of our program, for example, by inviting the travelling science show to their schools, by encouraging their students to attend the S.I.S.E. program and the Saturday Science Academy, and by applying for microgrants for their own projects.

Also, our high school apprentices have sometimes helped their younger brethren in the Saturday Science Academy.

As a final example (that by no means exhausts the list of examples), a minority faculty member in the Department of Mathematics at one of our participating universities learned a good deal about computing by means of a faculty internship. This person is now at the University of New Mexico as a visiting faculty member and one-year Resource Center staff member whose computer expertise is being put to good use in our programs (he coordinates the high school apprenticeship program and the science fair team). Also, he is the instructor for the computer course in the UNM math department that was mentioned previously.

Well, all this interaction is certainly beneficial, but a good deal of it is made possible by the specific nature of the Resource Center. However, other programs can themselves seek their own types of self-interaction to their own benefit.

b. Effectiveness of a Network. Another characteristic feature of the Southwest Resource Center is the network of cooperating institutions with concomitant personnel. The liaisons play a dual role. They are Resource Center employees and thereby have a responsibility to implement our programs and activities. At the same time, they are employees of their host institutions (some are even faculty members) and they pursue activities that are beneficial to their institutions. This often takes the form of securing funding for programs and activities at the host institutions. The experience gained in Resource Center activities is useful in seeking such funding.

Also, the liaisons interact and cooperate among themselves. They share ideas, contacts, materials, and resources.

Another advantage of having a network with a central fiscal agent is that savings in overhead and administration of grants are gained. It is often attractive to funding agencies to give a single grant to a network rather than several grants to individual elements of a network. Thus, one can get more effect per dollar in a network context.

This is all fine and good for a program that is as comprehensive as the Resource Center network. What can we say that might be of use to people that don't have the advantages afforded by the particular nature of a Resource Center?

c. The Central Importance of Teachers. In considering the problems of science education at the precollege level, one fairly obvious conclusion that we have reached is that teachers are of central importance to any solution

to these problems. There is no substitute for a well-trained, well-motivated, well-supported, and well-paid teacher. Such an individual can perform wonders. Such teachers are in no danger of being replaced by a computer software package.

As such, I would judge the Resource Center's summer workshops for teachers and counselors as being of fundamental importance. The teachers and counselors that we train in turn interact with masses of students. This is the most effective way of reaching large numbers of students and having positive effects on them.

I applaud the recent news from the National Science Foundation that $15 million will be made available next year for the training of teachers. We all need to turn our attention to teacher training and support.

d. The Saturday Science Academy. When I first got involved in precollege science education through the Resource Center, I thought that the lowest level we would work at would be middle school. After all, everyone says that kids make the fundamental decisions about their career choices in middle school. Elementary school students are adjudged to being too unformed or something. I believe our Saturday Science Academy experience will prove that one can have an effect on youngsters' career options even at the fourth and fifth grade level. Of course, it's too early to tell and the jury is still out.

However, we can speak affirmatively to the point that students at that age can be "turned on" to science and mathematics. I would also say that computers offer a very effective mechanism for developing such motivation and interest The kids take to the computers like ducks to water. We have found that the computer language LOGO is a particularly effective instrument for developing problem solving skills and spatial/graphical abilities.

I recommend to all concerned that they begin to dip down to these early levels in their planning for programs to encourage students in the pursuit of careers in science and engineering.

e. Science Fairs. In New Mexico, the science fair system is very well developed. Large numbers of students do science fair projects and many prizes are contributed to the science fairs by individuals, companies, and agencies. Science fairs are held locally at individual schools, at regional levels throughout the state, and at the state level. Indeed, the International Science and Engineering Fair will be held in Albuquerque in May of 1983.

It is of no surprise that minority group and female students do not participate in the science fair process to the extent that they should. Yet, science fairs offer students a great deal. They get a taste of what it's like to do a scientific investigation; they meet working scientists and engineers; they can gain material benefits (prizes, money, and scholarships); they gain experience and maturity in terms of self expression and critical thinking; they participate in social interactions, and the whole experience can be a lot of fun.

Well, we have given a crack at involving minority and female students (as well as everyone else) in science fairs. Our original approach had very limited success (one might even call it a failure); but I am happy to report that we have an approach now that is working.

Previously, we conducted science fair workshops of a generic sort for students. We would tell the students about the science fair process in general, and what makes a good project, and how to present one's project. The students would nod their heads in agreement and understanding, but not too many of the students who went through our workshops actually ended up doing a project.

We never answered the individual student's questions - namely, on what am I going to do a science fair project? How do I go about finding out about a topic in which I'm interested? etc.

We have now formed a science fair team and we give the students more individualized attention. We have helped them take their vague ideas as to what they want to look at and given them more specificity. We have identified mentors who can work individually with the team members. The team spirit also helps the students in terms of motivation, competition, and mutual support. The team members report regularly on their progress and they have to meet deadlines.

Already we can see that this approach is working much better. The first science fair competition is in March of 1983, but our students did participate in student poster sessions that were held in conjunction with our conference, "Science in the 80's", in October of this year. Students from all over the network participated. Our science fair team members (who are all from Albuquerque) walked off with the majority of the awards and prizes. So the indications are promising. We look forward to the regular science fair competitions.

The point here is that individualized attention is more effective than generic help. This is probably obvious. Now, if a student is from a nice middle class background with parents who can give him/her individual help, then our generic approach is effective. However, most of our kids don't have those advantages and with them, this individualized approach is much superior.

SUMMARY. We've tried lots of things in the three years of the existence of the Resource Center and most of them have been effective. No surprise! Money, commitment, and organization do have an effect.

A lot of the activities we have pursued are well precedented and have proven to be effective in other contexts. A few things we have done (like the Saturday Science Academy and the science fair team) are somewhat unique and it is these aspects of our program that are probably of most interest to others who themselves are devising means to improve the conditions of science education.

It has been a pleasure for one worker laboring in the trenches of science education to be able to share with you some of his experiences.

Mr. GRIEGO. I am a mathematician. And I am now director of a program called the "Southwest Resource Center for Science and Engineering." I am not an expert in science education but I was asked to head this effort that was funded by the National Science Foundation.

It is an extensive effort. It began in 1973 and the last year of its funding would be this year. The charge given to us by the National Science Foundation has been to focus on the minority and low-income groups, giving them access and opportunities in the areas of science and technology.

It is a regional program, quite large. It stems from Pueblo, Colo., north, down to El Paso in the south, the whole State of New Mexico, including the Navajo Reservation. It is a comprehensive program in that we work from grade schools all the way through postdoctoral level.

I really did not plan on speaking too much about the details of our particular program but Joyce Purcell has asked me to talk about one of the things that we have done in the Resource Center. One of the lessons that we have learned has been in working with little kids at the elementary school level. We have a program called the "Saturday Science Academy."

SCIENCE ORIENTATION POSSIBLE ON YOUNGER CHILDREN

Now, when I first came into this process of science education, I had been told by knowledgeable people that the critical age for youngsters is at the middle school level, you know, the junior high level; that that is the age at which youngsters are making career decisions and all that and that earlier than that probably really did not make too much sense to work at.

And we have found through the Saturday Science Academy and working with fourth and fifth graders and sixth graders, that one can be very successful in giving them substantial orientation toward careers in science giving them, well, making science and mathematics fun especially computers. You ought to see them go for the computers.

And we do not teach them video games, by the way. We teach them solid stuff.

I would recommend the Saturday Science Academy as a model for other people in other areas as a program that can be very effective for working with youngsters at the elementary school level. Indeed, our program will be made the subject of a television program, a national television program to be aired on PBS, WETA television from Washington is coming out with the film, "The Saturday Science Academy."

One of the lessons and in fact, one of the most important lessons that I have drawn from my experiences in the program has been the central importance of teachers and you have addressed that in your proposed legislation.

The Resource Center has had workshops for 250 teachers and counselors from this region. I am very pleased to see that your legislation addresses the whole issue of training and support of teachers.

COMPUTERS NO SUBSTITUTE FOR GOOD TEACHERS

There is no substitute for well-trained, well-motivated, well-supported and well-paid teachers. Such a person can perform wonders and I believe that such a person is in no danger of being replaced by a computer software package, as some people have been talking about lately. Because teachers interact with masses of students and this is the most effective way of reaching large numbers of students and having positive effects on them.

UNIVERSITIES NOT ADEQUATELY TRAINING TEACHERS

I was chairman of the Department of Mathematics at our university before I became director of the Resource Center. I came to realize that our universities are really not doing the sort of job for the training of science and mathematics teachers that we should be doing.

Mathematicians and mathematics departments get paid for doing research. When I was chairman, I came to realize that the whole burden in a faculty of almost 40, for training teachers for public schools fell on the shoulders of one single faculty member in our department. I think that is not wise.

We have got at the university level, to do something about changing the reward system so that there will be more rewards for getting involved in the training of teachers in the public schools. I will be making such recommendations to our university administration before too long.

Speaking of teacher training, I am happy to see that the National Science Foundation has recently allocated $15 million for a program for teacher training and I think this is very important.

Speaking of the National Science Foundation, there is a great deal of concern in the science and science education community about the effective dissolution of the National Science Foundation Science Education Directorate. I am sure you know about this.

Senator DOMENICI. Yes.

FED HELP WORKING AT CROSS-PURPOSES

Dr. GRIEGO. That the NSF Science Education Directorate has essentially been eliminated. At one point, the only charge it was going to have in the future was to continue administering some scholarship moneys they had and there was no future funding in line for them. The $15 million is a new amount of money that has been given to them.

I think this is very ill advised. It seems like the Federal Government is working at cross-purposes.

On the one hand, we are told that there is a great deal of concern about the shortage of math teachers and science teachers and declining scores on standardized examinations, the technological threat that is posed by Japan and West Germany and other industrialized countries.

On the other hand, we find that a major force in science education at the national level, the major force, is being dissolved and I think for reasons that have nothing to do with this crisis of science

education that we are dealing with, I think for reasons having to do with more ideological nature, and I think it is very ill-advised.

FED HELP SHOULD BE THROUGH NSF

I insist on the proper and legitimate role for the Federal Government in science education. Some words have been said today, well, decrying, perhaps the intrusion of the Federal Government into States. I do believe there is a proper role. I think that an important task would be to analyze the role and function, of a science education effort at the national level and I would hope that role could reside in the National Science Foundation rather than the Department of Education, because it gives it, for good reasons or bad, more status in the scientific community.

Up to now, science education has been somewhat of an orphan child and I think we have to do something about changing that.

HIGH TECH DEVELOPMENT COULD HURT NEW MEXICO

Looking at the Southwest, there has been a lot of talk about future high technology industrial development that is going to occur in the Sun Belt, including New Mexico.

Now, in my discussion with people around the State, there have been expressions of mixed feelings toward these potentialities. I am not at all convinced that such industrial development would be a panacea. After all, there will be limited jobs in the higher levels of such industry, jobs such as engineers, scientists, and other professionals. By far, most jobs will be at semiskilled, clerical, and other support areas.

And it is incumbent upon us to prepare our people to assume jobs at the highest levels in such industries. Otherwise we run the risk of exascerbating existing social and economic inequities that exist among our people. I believe that that is our task and I will devote myself to it. In my career at the university I have been devoting myself toward solving some of these social problems, especially as they regard science and technology. I look forward to this legislation as being another step in working in that direction.

Thank you very much.

NSF SCIENCE AND ENGINEERING DIRECTORSHIPS COMBINED

Senator DOMENICI. Thank you very much, Doctor. I have a couple of questions later. With respect to your concern about the NSF's Science Directorship, I am not suggesting that the recommendation contained in the budget document is correct, but let me tell you the fact and then you can think about it and perhaps communicate with our staff.

What NSF proposes is a combination of what previously was an engineering directorship and a science directorship. It would now be a science and engineering directorship and the funding levels would go up 13 percent to $39 million.

I am not sure that that is right and I am not sure that that is enough but that is the story and I would, because I have great respect for your personal involvement and understanding, I would like your comments later, certainly, if not today.

CLEAVAGE DEVELOPING AMONG EDUCATORS

I would want to make one other comment. You will note in this bill, when you get a chance to look at it carefully, if you have not, that somehow or another, there is a cleavage developing between the educators, their representative associations and NSF.

You and the NSF are very proud of NSF's scientific prowess, their great capacity in peer review and their real scientific excellence.

The educational associations, boards, school boards, Associations of teachers, NEA, et cetera, while not jealous of that, are saying, if you are going to get more involved in schools and science, you cannot do it with just NSF.

That is why you will find that, you know, we border between getting NSF saying, "We will not support the bill" to all education associations saying, "We will not support a bill," if NSF has complete jurisdiction and imposes itself on school boards.

We first drew it saying, "Where do we get most support to pass a bill?" Because, that is what we want to pass, a bill, and one that is good. The first premise was, "Forget NSF. We love them. But, there are not very many of them around."

Dr. GRIEGO. Not any more. [Laughter.]

Senator DOMENICI. The final product does not do that at all. The final product involves the school people, and very fortunately today we got the endorsement of all of the national science teachers, if I heard our witness right. We have also retained the expertise of NSF in the scholarships and grants portion of the bill. NSF will pass judgment on who is best, but we set up the commissions on excellence to set the standards. And, we have used the public boards of education or their counterparts and local school boards so that they too are involved in the action. It has got to be that way, it seems to me, or what we will end up with is a little more funding in NSF, another trial run, and we will not get the local school boards involved in pushing for what we really have to do for the continuation that has been spoken of today.

Let us go on to the next witness unless you have something, Jeff.

Senator BINGAMAN. I have nothing further.

Senator DOMENICI. Dr. Resta.

STATEMENT OF DR. PAUL RESTA, ASSISTANT DEAN OF THE SCHOOL OF EDUCATION, UNIVERSITY OF NEW MEXICO, AND PRESIDENT, NEW MEXICO COUNCIL OF COMPUTER USERS IN EDUCATION

Dr. RESTA. It is a pleasure to be here.

I would like to address some remarks on some of the problem areas relating to our present decline in the technological literacy of our population that perhaps have not been well stressed, you know, in the earlier testimonies.

One, that we did not address, and I recognize on the one hand that it does not fall under the purview of the bill but I would like to mention that in passing, is that part of our problem today, to some extent, is due to limited facilities in math and science as well as what I will say is technology.

TEACHING FACILITIES OUTDATED

Many of our facilities are outdated. At the present time, as president of the New Mexico Council of Computer Users in Education I have found, paradoxically, that computer technology is infused into all elements of our business and industrial and military and government sectors. At the same time, the fruits of this technology appear last within our educational institutions.

I think that one of the concerns I have about the bill is that as we define math and science, I hope we do not take a highly provincial view. I think that some of us had legitimate concerns in terms of whether computer education would fall under the purview of math and science.

In some respects, the use of computers as tools is one of the most important steps that our population needs to take in terms of increased productivity, in terms in the work environment.

I could see that computers as tools and as instructional delivery systems can play a key role in our educational institutions. If we really hope that computer use today will lead to expanded productivity in the future work market, we should be providing opportunities for our students to use information technology as tools in all aspects of the learning process.

I think there are some very exciting developments happening nationally at the higher education levels. Two universities, Carnegie-Mellon and Drexel University, are requiring students to utilize microcomputers for a variety of tasks in the instructional process. I think that is pointing the way in terms of some of the needs for developing computer literacy, not in the narrow sense but in the broad sense of being able to use these technologies in all aspects of our working life.

TECHNOLOGICAL COURSES SHOULD BE ADDED TO BILL

In looking at math and science I do hope that we will also look for all the opportunities for inculcating math and science beyond just the traditional academic discipline. I would like to point out a difference to my colleagues here. In the earlier episodes with the National Science Foundation development of curriculum and activities I believe many opportunities were missed in addressing it in the traditional academic role.

I think that is of paramount importance. We do need to have engineers, chemists, physicists, biologists for our country to compete in this high technology, high stakes race that we are in. But as the director from Los Alamos pointed cut, what we also need is a technologically literate population. That technological literacy should not just address traditional math and science courses. It should include a lot of the occupational, vocational courses that are offered as part of a curriculum. I hope that as we look at the bill, that we will look at it in terms of all of the opportunities for developing not only math and science, but technological competency as well.

I had some other comments relating to the problems and the needs but those are covered in the paper and I would be happy to respond to those at a later time.

Senator DOMENICI. Thank you very much, Doctor.

Dr. Muller.

STATEMENT OF DR. WERNER MULLER, PROFESSOR OF SCIENCE EDUCATION, HIGHLANDS UNIVERSITY

Dr. MULLER. Thank you.

Senator DOMENICI. Welcome, Doctor. Doctor, is there not another professor from your school with a class here today?

Dr. SCHULTZ. Yes.

Senator DOMENICI. Yes?

Dr. SCHULTZ. Dr. Dorothy Schultz.

Senator DOMENICI. And you have your class here?

Dr. SCHULTZ. Right, my government business class.

Senator DOMENICI. Would your class stand up?

[The class stands up and is recognized.]

Senator DOMENICI. Well, thank you very much for bringing them and thank you for coming.

Dr. SCHULTZ. Thank you.

Dr. MULLER. That is quite a surprise.

Senator DOMENICI. I should have told you, Doctor.

Dr. MULLER. Yes, you should have warned me. I did not realize they were here.

Senator DOMENICI. I apologize.

Dr. MULLER. Well, I appreciate the opportunity to come before the panel and thank you very much, Senator Domenici, for inviting me.

I come to the panel with a little bit of a plea that will end, I hope, in some specific ways in which I think your bill might be able to accommodate some change in science education and I support the effort that is being made.

I have been hearing this afternoon lots of comments relative to the first press for improvement of science and math education. As one of the products of that movement, I think it might be appropriate to share with you a few little incidents that may be instructive in terms of how to proceed from here.

I myself was a graduate in chemistry and worked in cancer research for quite a few years. I later made the decision to go into science education as a result of the efforts in support of the National Defense Education Act in the early 1960's.

NATIONAL DEFENSE EDUCATION ACT

My master's and doctoral program took me away from research and medicine into education which was quite attractive to me because I was interested in a service type of lifestyle. I wanted to work in the service areas, work with people. The National Defense Education Act put me in contact with the resources and the expertise of the people at Colmbia University. One of them was the protege of Paul de Hart Hurd from Stanford University, who was mentioned in the Wall Street Journal as being the dean of the Nation's science teachers.

My adviser and immediate chairman was Dr. Mary Budd Rowe, who has had quite an impact on science education in this country.

I mention that because, having received a doctorate in science education, I have found a rather cool reception to science educators at the university levels. I think that is instructive. I think it is instructive to know that I was the first and am the only doctorate in

science education at New Mexico Highlands University, to my knowledge, and I arrived 13 years ago.

It is interesting that when I talked to people about the position at Highlands, I was hustled through the science department, directly into the education department, because that was the word that stuck out in their minds. My résumé, my background had nothing to do whatsoever with the assignment. All they heard was the education portion, and I was in education.

Senator DOMENICI. That is somewhat similar to what Dr. Griego was saying about math before.

Dr. MULLER. Yes.

Senator DOMENICI. If I understood you correctly.

Dr. MULLER. Yes. It is a kind of an interesting problem we have because when you look at what is happening in the field of science education, the impact that science educators have had, it seems relatively minimal. I was indoctrinated in the science curriculum improvement study with Dr. Karplus, Robert Karplus; Willard Jacobsen and the science of process approach, triple AS program.

I came to New Mexico, and because of some bilingual funding I was able to do a workshop in SCIS, but only once or twice. If you look at the approved book list, the State adoptive list of science programs, what Jeanne Knight was saying is perfectly true. Those programs are not in the curriculum for the elementary school teachers any more.

I asked a high school student about science teachers in reference to education, the education issue and the response was, from a high school student, "There are plenty of bright people in high schools who know a lot about science but we need people who can teach it."

There was another thing that was interesting. I would like to hypothesize. If you ask a college teacher of science, chemistry, physics, biology, what he perceives himself as professionally, I would hypothesize that he will tell you he sees himself as a scientist.

If you ask him, "How do you earn your living?" he will tell you, "By teaching."

Then if you ask him, "Do you consider yourself a teacher or a scientist?" he will say, "Scientist."

At one point in the discussion we were talking about science education and the comment was made,

> To improve science teachers in the United States, what we need to do is give them 2 years of biology, 2 years of physics, 2 years of chemistry and burn the education building.

Remember the high school student who said,

> There are plenty of bright people but what we need are teachers of science.

I then went and I asked my teachers who were in the education courses and the methodology courses, "What science background have you had?"

And they answered, "Well, we have taken the three survey courses in science at the college level."

They have taken remedial courses in mathematics. They met the minimum requirements in science and math at high school level and, in fact, they probably had 9 years of science and 9 years of mathematics in the public schools and I asked them, "What do you

feel most comfortable teaching in the elementary or junior high school?" and they never mentioned mathematics or science.

If you look at their programs, they have taken more math courses and more science courses than any other course and the course they said they feel most comfortable teaching is reading.

I ask you, why do they feel comfortable teaching reading? It is because it is something they have practiced and practiced and practiced and they feel they can do it.

LEVEL OF COMPETENCY OF TEACHERS

However, we read statistics or hear data like,

The average level of competency for teachers in the country is fifth grade in mathematics and seventh grade in reading.

How could they have taken so many courses in science and mathematics without having gained some basic competencies in those areas?

If you look at the teacher training programs, and I refer specifically to New Mexico Highlands University, 9 percent of their total program before graduation, whether it is to teach science or just a general core curriculum, for the elementary majors, 9 percent of the total programs are the science courses; 1 percent is in science education.

At the secondary school level, not only do they major in their science area and perhaps minor in it, they are not even required to come and say "Hello" to me as the only science educator on the campus.

My kindest thoughts go to Paul de Hart Hurd in Stanford University and the NDEA and SCIS and AAS for all the investments that we have made. But, until some attitudes change about the role of the science teacher in the public school, whether it is through encouragement, enticement, getting the children excited about science, these, I think, are the issues.

STUDENTS WILL MEET DEMANDS PLACED UPON THEM

Mr. Jennings mentioned that he thinks our students will rise to the demand if we demand something from them, they will meet our expectations. I agree 100 percent.

I will go one step further. If we demand quality teaching from teachers, if we demand competencies from teachers, if we pay for it and if we monitor it, we will get it. We have got to take care of the professionals, begin to respect teaching, teaching science in particular, as prestigious, as respectable, professional work and to provide the incentive for going into that area.

It is very exciting and young people are very exciting.

It is a shame more contact is not made with them.

I asked my science teachers, "Tell me what your experiences have been in science. Why are you afraid to teach science and mathematics?"

In spite of the exposure that they have had, they express anxiety over their performance and participation in science classes and the expectations that they have of themselves as science teachers. I said, "Where did you get those expectations?"

Reflecting on their specific experiences in science courses, they reported a heavy emphasis on memorization, recall of factual information, formulas, symbols, labels specific to various disciplines in science and I contend they are learning the language of the discipline.

SCIENTISTS STEREOTYPED

They describe very stereotyped pictures of scientists geniuses in white coats who are perceived as oracles of truth and almost untouchable. In general, their view of science and scientists is awesome and imposing, a perception that is impossible to adapt to themselves. They cannot be science teachers and be exciting to themselves if they think they have to be that kind of person.

Most elementary schoolteachers are threatened at the very thought that they will be asked to assume the role of a science teacher.

I asked them to go out and interview the science faculty in the New Mexico Highlands University. These are the expertise that was represented: mycology, geology, nonmetallic inorganic chemistry, ecology, theoretical physics, biology, chemistry, high pressure and optical physics, a frightening array of specializations. You know what they found out?

They asked them one question, that I asked them to ask those scientists, "What do you like most about being a scientist?"

Here is what the scientists said, "Being able to discover knowledge." "The thrill of making scientific discoveries." "Satisfying my curiosity." "Finding out what makes things work." "Challenging the unknown." "The enjoyment of discovery."

Not one scientist mentioned "Memorizing the formula for converting farenheit to centigrade." [Laughter.]

Not one scientist mentioned "Memorizing names used in the scientific taxonomies." Not one scientist mentioned memorizing Garth's laws as something they liked most about being a scientist.

Now, what do they teach our students and ask them to memorize? The very things that they do not like that they do not even recall as being important and exciting to them, as being scientists.

I would suggest to you that our teachers be given support in developing their ability to science, that they communicate the excitement of sciencing to children, that they incorporate mathematics as a language for describing events that they observe and see and hypothesize about, that they begin to use computers as an information-processing tool, not as a game, that we try to build computers and computer language so that we help them to process the information that they gather through their other skills.

I would like to suggest that the elementary and secondary schools focus attention on something that would be rather broadly adaptable to cultures and history and environments that they find themselves in and that is, to teach children some fundamental skills other than describing, graphing, measuring, hypothesizing, interpreting, the things that are exciting to the scientists.

It took me until graduate school to go into a laboratory and do my own research and then I discovered how it was done. It was

very exciting and very interesting. But in order to get into that door, you had to memorize everything.

I challenge you to go to a chemist, in this room or at Sandia Labs, and ask him what the melting point of mercury is. He will look it up.

They would never last if they were asked or were expected to memorize. Scientists do not see themselves as computer banks of information.

I would like to help children sharpen their skills so that they are able to perform these skills in systematic and productive ways, developing the confidence needed to challenge unknown questions. I often ask my teachers, "What will happen if a child asks you,'Does a frog eat rocks?"

Will they say, "That is a stupid question. Of course not. Don't you know any biology?" Or will they say, "That is interesting. I don't know. How can we find out?"

Will teachers have the skills and the confidence in their ability to examine natural phenomena in terms of physical properties, distinguish between quantitative and qualitative descriptions? I think you will be shocked if you find out, if you were to know how many young people cannot measure the length of a line with a ruler who are sophomores and juniors in college and the reason is, not because they are dumb, but because they have never had the opportunity to practice that skill.

Let me turn now to some of the places that I think we could be using, incorporating or enriching our science experiences through your bill.

ESTABLISH EDUCATIONAL RESOURCE CENTERS

I would like to see science, math, and computer educational resource centers available to rural schools and to urban schools, perhaps based at universities, where teachers could go for support or students could go for support and communities could go for support.

I think they could provide teaching materials, films, books, equipment, access to programs and curricula, like a library, software and hardware for computers and so forth but provide that educational resource center.

I think that would fit very well under title III.

Graduate fellowship programs. I would like to see a master's in science and math education be reinstituted so these people can go out and provide the leadership in the public schools and perhaps the science, elementary science and math specialists as well. I think that would fit under title I and comfortably under titles II and III.

Mobile science, math and computer units for providing rural areas with some of the excitement and the resources that are available at the resource center. I think that would be appropriate for title III.

TEACHERS SHOULD HAVE PRAISE COMPETENCIES

Curriculum and training, testing and development I think we need to ask that our teachers of science have the basic competencies that we want our children to learn.

High school science teachers say to me, "They come to us, they don't know how to measure. They do not know how to graph. They do not know how to do these things." If we could do nothing else but have our elementary children develop competence in those skills, I think we would make a great contribution. That is going to take curriculum and testing development.

I think we ought to demand competency of our teachers in those same areas. If the teachers cannot do it, they will not teach it.

I think that would fall very well under title II of the commission on excellence.

I hope that some of these comments and ideas and suggestions give some food for thought and I would like to see you continue your efforts along these lines and all I can say is, if you demand something of people and expect it of them, they will perform, but you must demand it.

Thank you.

Senator DOMENICI. Thank you very much. Doctor, are you a scientist or an educator? [Laughter.]

Dr. MULLER. I feel like I am a science educator. [Laughter.]

Senator DOMENICI. I tell you, when I did my practice teaching at Albuquerque High, it was in chemistry and I assure you that my fears were justified. A young man in this town who is the president of a bank, almost burned the lab down at Albuquerque High because I forgot to teach him the properties of one of the little bottles there. He, instead of putting a nonvolatile substance on the Bunsen burner, put one that would have burned up by itself, just by taking the lid off the bottle—we had a hell of a fire.

Maybe I can tell you who it is, now. He never wanted to be a chemist. His name is Fred Luthy, Junior.

Let us go to our next witness, Dr. Fred Begay.

Dr. Begay, we are delighted to have you here.

STATEMENT OF DR. FRED BEGAY, STAFF PHYSICIST, LOS ALAMOS SCIENTIFIC LABORATORY

Dr. BEGAY. Good afternoon, Senator Domenici, Senator Bingaman, Senator Jennings, and Representative Vigil.

I wish to express my sincere appreciation to you for inviting me to participate in this crucial hearing.

My name is Fred Begay. My parents come from the Navajo Reservation near Navajo Mountains in Utah. I am a member of the Navajo Tribe.

My interest in science and mathematics began when I was a young child. I had many questions about the origin of natural phenomena.

However, my questions were not considered until I entered college. I began studying formal English in college. After my family and I—I was one of seven children—had struggled through many years of hardship, I was awarded the Ph.D in nuclear physics at the University of New Mexico.

I am presently employed at the Los Alamos National Laboratory as a staff physicist where I work in the laser fusion program. Also, I served as a member of the National Academy of Sciences Advisory Committee on Science and Technology for the Navajo Nation.

In May 1982, the National Academies of Science and Engineering held a national convocation to consider the state of precollege education in mathematics and science in the United States.

PRECOLLEGE MATH AND SCIENCE EDUCATION DETERIORATING

The following trend in precollege science and mathematics education was revealed: Precollege science and mathematics education is deteriorating. The evidence for this trend takes several forms, some are quantitative.

There are declines in scholastic aptitude test scores, declines in the number of high school graduates having taken the given number of years of science and declines in the number of teachers certified to teach science and mathematics in school.

Some are qualitative. In particular, the evidence for an early disenchantment with science and mathematics by children, who usually start out being natural scientists, is very strong.

An attempt to arrest the erosion of science in education and in math education in this country is imperative. We must draw on the resources of the Federal, State, and local governments, the industrial sector and school systems such as universities, community colleges, elementary and secondary schools, in a coherent and effective manner.

This critical problem must be solved if our Nation is to survive.

SOCIETY SHOULD FULFILL ITS PROMISE TO ITS CHILDREN

I would like to mention a quotation here which was made by the State in the "State of School Science" in 1979. "It is a call on American society to redeem its promise to its children. That is, to fulfill their right to the best education society can provide. The liberating objective of scientific literacy cannot be accomplished by a one-time effort.

What is required is the permanent, sustained and increasing commitment of the American scientific community.

For people to care about educating their children in mathematics and science, they must appreciate the role of science and technology in modern society in the world of work, in international markets, in peoples, health and longevity.

Therefore, initiatives to improve science and mathematics education in schools must be coupled with programs to further public understanding of science and technology. The scientific literature of our citizenry is completely inadequate for dealing with today's issues and problems.

SCIENCE AND MATH EDUCATION FOR THE AMERICAN INDIAN

I wish now, briefly, to express my views on science and mathematics education for the American Indian. I have compiled some data in a table which I have submitted to your staff that the

American Indian is poorly represented in the scientific community.[1]

For example, 0.3 percent of Indian individuals have Ph. D.'s in the physical sciences. Let me offer three primary factors which have defined and supported this trend in Indian representation in the scientific community. Let me apply the Navajo case as an example because I am more familiar with that.

Factor No. 1. The Navajo economy.

The economy of the Navajo Reservation is underdeveloped. The Navajo economy is not much different from the economy in Third World countries. You know, the economy has another characteristic here that is similar to Third World countries which is that we have large deposits of coal and uranium on the Navajo Reservation.

Because of the lack of qualified Navajo technical advisers, the Navajo nation has not been able to effectively design and implement an appropriate economic development program.

Factor No. 2. The education system.

Both Historically, and from my personal experiences, the quality of education has generally been poor. There exists a severe problem in remote areas such as the Navajo Reservation in recruiting qualified teachers and administrators.

Factor No. 3. The language problem.

From my personal observations, Navajo children from Navajo traditional homes have developed skills in abstract thinking in the Navajo language. I find that certain Western scientific concepts are embedded in many Navajo mythologies.

To name a few, the concepts of laser, radiation, electricity, gravitation, cosmology, astronomy. However, these concepts are buried in archaic Navajo language form.

Through the assistance of the Navajo medicine men which know this language, I am now able to present a lecture on laser fusion in Navajo with no English words.

I wish to point out that the Navajo children who have learned the Navajo mythologies at home have developed skills in abstract thinking which are necessary for understanding Western science and mathematics concepts.

However, there exists an inherent problem in this lenguage system, Navajo versus English. Today, teachers, students, and parents are unaware of this correlation between Navajo and Western science concepts. I am wondering how long it will take for the Navajo education community to recognize and utilize this aspect of Navajo culture.

ESTABLISH PROGRAM IN INDIAN SCHOOLS

I wish to submit a recommendation in title III, section II of the act. I have a deep concern about the character of the science and mathematics education program for children in Indian schools. I wish to recommend that the Secretary of Education submit a request to the National Academy of Sciences to provide technical as-

[1]The table referred to can be found on p. 114.

sistance in the design and implementation of a viable science and mathematics education program for children in Indian schools.

The Academy can provide the leadership in focusing on the objectives and goals of science and mathematics education and promote an understanding amongst those who teach the relationship of science and technology to society.

I have talked to Dr. Frank Press about this recommendation and he is willing to consider it and to present it to the Academy Board.

I strongly support the National Mathematics and Science Excellence in Education Act of 1983. I wish to offer two primary reasons for this support.

It is essential that the American Indian be a well-informed citizen on scientific and technical issues in the English language.

My second reason is that many American Indian tribes are required to make policy decisions on the utilization of their natural resources. Because the Tribes are faced with the lack of Indian scientific and technical advisers within the tribe, it has been difficult to make sound policy decisions on natural resource issues.

This is detrimental not only to the Navajos but also to the entire United States. With resources from the act, perhaps we can train desperately needed qualified engineers and scientists to help with the economic development of the American Indian society.

We desperately need to improve our educational institutions so we can undertake challenges in the economic development process. The proper application of sound, effective and unified educational economic development programs can lead to the generation of productive and responsible citizens who can make contributions to the advancement of western civilization.

Thank you.

Senator DOMENICI. Thank you.

Testimony by Fred Begay

LEGISLATION: THE NATIONAL MATH AND SCIENCE EXCELLENCE IN EDUCATION ACT OF 1983

Good afternoon, Chairman Domenici and other members of the Senate Committee on the Budget.

I wish to express my sincere appreciation to you for inviting me to participate in this crucial hearing.

My name is Fred Begay. My parents come from the Navajo Reservation near Navajo Mountain in Utah. I was born on the Ute Mountain Indian Reservation in Colorado. I spent the first 18 years of my life on the Ute and Navajo Reservations. I am a member of the Navajo tribe. I was trained to be a farmer at the Bureau of Indian Affairs Indian Vocational School. I spent four years in military service during the Korean Conflict.

My interest in science and mathematics began when I was a young child. I had many questions about the origin of natural phenomena. However, my questions were not considered until I entered college. I began studying formal English in college. My college program consisted of college courses during the day and high school courses at night. My career in physics can be considered as an accident.

After my family (wife and seven children) and I struggled through many years of hardship, I was awarded the Ph. D. in physics at the University of New Mexico. My major studies in graduate school were in nuclear physics.

I am presently employed at the Los Alamos National Laboratory as a staff physicist. I work in the laser fusion program as a plasma physicist. Furthermore, I work as a dedicated servant, to advance the search into the mysteries and marvelous simplicities of this strange and beautiful universe, our home. My goal as a physicist is to discover the

inner workings of the machinery of nature. I am told that I am the only Navajo Ph.D. physicist in this country. Also, I serve as a member of the National Academy of Sciences Advisory Committee on Science and Technology for the Navajo Nation.

In May 1982, the National Academies of Science and Engineering held a national convocation to consider the state of precollege education in mathematics and science in the United States. The following trend in precollege science and mathematics education was revealed.

Precollege science and mathematics education is deteriorating. The evidence for this trend takes several forms. Some are quantative: Declines in Scholastic Aptitude Test (SAT) scores, declines in the number of high school graduates having taken a given number of years of science, and declines in the number of teachers certified to teach science and mathematics. Some are qualitative: In particular, the evidence for an early disenchantment with science and mathematics by children who usually start out being 'natural scientists.'

In an attempt to arrest the erosion of science and education in this country, we must draw on the resources of the Federal, State, and local Governments, the industrial sector, and school systems (universities, community colleges, elementary and secondary schools) in a coherent and effective manner. This critical problem must be solved if our nation is to survive.

"It is a call on American society to redeem its promise to its children: That is, to fulfill their right to the best education society can provide. The liberating objective of scientific literacy cannot be accomplished by a one-time effort. What is required is the permanent, sustained, and increasing commitment of the American scientific community." (The State of School Science, 1979.)

For people to care about educating their children in mathematics and science, they must appreciate the role of science and technology in modern society, in the world of work, in international markets, in people's health and longevity. Therefore, initiatives to improve science and mathematics education in schools must be coupled with programs to further public understanding of science and technology. The scientific literacy of our citizenry is completely inadequate for dealing with todays issues and problems.

I wish now to express my views on science and mathematics education for the American Indian. The data shown in the Table I indicates that the American Indian is poorly represented in the scientific community. The first column of numbers in the race column indicate the number of individuals in respective professions. The second column of numbers with parenthesis are the number in the race population per profession. It should be pointed out that the number of American Indians represented in the Table is an upper limit. This is the case since many individuals with negligible Indian blood count themselves as American Indian. The third column of numbers under American Indian is the percent of Indian individuals relative to White individuals for each profession and degree status. For example, 0.3% Indian individuals have Ph.D.s in the physical sciences. Let me discuss three primary factors which have defined and supported this trend in Indian representation in the scientific community. (Let me apply the Navajo case as an example.)

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1. The Navajo Ecomony. The economy on the Navajo Reservation is underdeveloped. The Navajo economy is not much different from economies in Third World countries. For example, 39% of the homes have electricity, 20% of the homes have water facilities, 8.4% of the homes have standard inside plumbing, the unemployment level is at 75%, and the average annual income per capita is $900.00.

   On the other hand, there exist large deposits of coal and uranium on the Navajo reservation. There exists 3.78 billion tons of coal reserves which is 6% of the total economically accessible coal reserves in the Western states. Also, 55% of the U.S. uranium reserves are on Indian lands.

   Because of the lack of qualified Navajo technical advisors, the Navajo Nation has not been able to effectively design and implement an appropriate economic development program.

2. The Education System. Historically and from my personal experiences, the quality of education has generally been poor. This suggests that the teachers and the administrators that guide these teachers are generally poorly qualified. There exists a severe problem in remote areas, such as the Navajo Reservation, in recruiting qualified teachers and administrators. The need for innovative recruitment programs is important, which should include appropriate salary adjustments. Also, it is important to encourage Navajo individuals to undertake careers in science and mathematics education.

3. The Language Problem. From my personal observations, Navajo children from Navajo traditional homes have developed skills in abstract thinking in the Navajo language. I find that certain Western scientific concepts are embedded in many Navajo mythologies. For example, the concepts of the laser, radiation, electricity, and gravitation have been alluded to in Navajo mythologies. Also, concepts in cosmology and astronomy are present. An essential requirement for the effective application of science and mathematics education is the proper understanding of the scientific and mathematical concepts. The Navajo mythologies are generally spoken in an archaic Navajo language form. This language is used exclusively by the Navajo medicine people. Through the assistance of the Navajo medicine people I am now able to present a lecture on laser fusion in the Navajo language.

The point I am trying to make here is that the Navajo children who have learned the Navajo mythologies at home have developed skills in abstract thinking which are necessary for understanding Western science and mathematics concepts. However, there exists an inherent problem in this language system - Navajo versus English. Today, the teachers, the students, and the parents are not aware of the correlation between the Navajo and Western science concepts. This correlation is not known because it requires a deep understanding of the structure of nature; on the one hand, an individual must learn an archaic form of the Navajo language to discuss the Navajo view of nature, and on the other hand, the same individual must learn physics and mathematics to discuss the modern view of nature. Mathematics is the language of physics. Consequently,

in order to appreciate this correlation, one must learn two complicated languages at an abstract level. With the help of the Navajo medicine people, I give lectures on modern science in Navajo, and I point out to the students, teachers and parents that the Navajo words I use come from Navajo mythologies. How long will it take for the Navajo education community to recognize and utilize this aspect of Navajo culture?

I wish to submit a recommendation in Title III, Section II of the Act. I have a deep concern about the character of the Science and Mathematics Education Program for children in Indian schools. I wish to recommend that the Secretary of Education submit a request to the National Academy of Sciences to provide technical assistance in the design and implementation of a viable Science and Mathematics Education Program for children in Indian Schools. The Academy can provide the leadership in focusing on the objectives and goals of science and mathemataics education, and promote an understanding amongst those who teach of the relation of science and technology to society.

I strongly support the National Mathematics and Science Excellence in Education Act of 1983. I wish to offer two primary reasons for this support; (1) the religion and philosophy of the American Indian addresses in some detail the structure of nature in his own language of nature. With support form this Act, perhaps we can discover new scientific and mathematical concepts which are buried in the American Indian language of nature. Furthermore, it is essential that the American Indian be well informed citizens on scientific and technical issues in the English language. (2) Today, many American Indian tribes are required to make policy decision on the utilization of their natural resources. Because

the Tribes are faced with the lack of Indian scientific and technical advisors within the Tribe, it has been difficult to make sound policy decisions on natural resource issues. This is detrimental not only to the Navajos but to the entire U.S.A. With resources from the Act, perhaps we can train desperately needed qualified engineers and scientists to help with the economic development of the American Indian society. We desperately need to improve our educational institutions so that we can undertake challenges in the economic development process. The proper application of sound, effective and unified educational-economic development programs can lead to the generation of productive and responsible citizens who can make contributions to the advancement of Western civilization.

TABLE I

SUMMARY OF PROFESSIONALS IN SCIENCE, MATHEMATICS AND EDUCATION

FIELD	DEGREE	WHITE	AMERICAN INDIAN	%
Physical Science	Bachelor	20958 (8991)	63 (21572)	0.3
Mathematics	"	10229 (18423)	41 (33147)	0.4
Engineering	"	52651 (3579)	164 (8286)	0.3
Education	"	108984 (1729)	645 (2107)	0.6
Physical Science	Masters	4373 (43094)	29 (46863)	0.6
Mathematics	"	2352 (80124)	8 (169878)	0.3
Engineering	"	10082 (18691)	24 (56626)	0.2
Education	"	93994 (2004)	451 (3013)	0.4
Physical Science	Ph.D.	12987 (14510)	51 (26647)	0.3
Mathematics	"	3023 (62339)	15 (90602)	0.4
Engineering	"	6452 (29208)	24 (56626)	0.3
Education	"	22211 (8484)	178 (7634)	0.8
Science Education	"	344 (547825)	2 (679514)	0.5

SOURCE: Professional Women and Minorities, A Manpower Data Resource Service, Scientific Manpower Commission, 3rd Edition, April 1982.

Senator DOMENICI. Let me take a couple of minutes and talk with you, Doctor. You have made an issue here today about development of Indian resources that is absolutely, unequivocally correct. nect.

New Mexico State University, for about 3 years, has recognized what you said. Let me put it this way.

When we started putting a lot of money into Indian scholarships and grant programs for higher education, had we known what you are saying, we would have set up a system that would have had Indian people, men and women, educated in the areas you are speaking of, experts in oil and gas, experts in coal development, experts in agriculture, with Ph.D.'s and experience. We did not.

In fact, when you look back at the array, we educated many but in the fields you speak of, few.

NO CONFIDENCE IN INFORMATION RECEIVED

Consequently, there is no confidence on the part of Indian leaders themselves that the information they are getting, which never comes from their own, is the information they should follow.

Or, the few Navajos that are educated in the appropriate disciplines, good, sound Ph. D. in agricultural economics who go back to the reservation, cannot stay. Too much is expected of them. They are expected to be experts on everything and they cannot be. There is nobody around in the other fields that are like them.

Aside from this bill, I would think that, we could find a way in the next decade, to specialize in those areas, where there is plenty of talent. We are told by New Mexico State that in the areas of math and science it is a myth. Those who say the Indian People do not have an inclination, enough basic talent, are wrong. The Indian people do have a basic talent in fact, in those areas.

I think we would make the biggest contribution to their economic development and ours. I only hope that when we get that study, that you will help me.

Dr. BEGAY. I would certainly be glad to, sir.

Senator DOMENICI. We do not need this bill to get the academy to do that. We ought to have that done, what you suggested. We will try to do that.

Dr. BEGAY. Well, the motivation for the academy is that the Navajo has waited for over a century, you know, for federal responsibilities. I have spoken to BIA last week, and they are very agreeable.

They know. I said, you know we need it. We need that help. We need recommendations on just how to proceed, so that is sort of the way I am proceeding with this.

Senator DOMENICI. I have no further questions.

Jeff?

USE OF PUBLIC TV STATIONS

Senator BINGAMAN. I just wanted to ask the three gentlemen here from the University of New Mexico. I believe our educational television station here is half-supported by the university and half by the Albuquerque Public Schools.

It seems to me, just thinking back, that when we had the first big push toward educational excellence in the sciences in the late 1950's and early 1960's we had a lot more emphasis in public television and in television in general on scientific matters. It seems that we have gotten away from that in the programing for channel 5 here and I guess maybe all of our educational stations around the country.

How are those decisions made? What can be done?

I can remember when I was going through high school there was a physics program that was on at 6:30 every morning and you could watch it for a half-hour while you had breakfast and then you could get credit for it.

Now, I do not think that is still on. Maybe it is. I have been watching the "Today" program recently. Is there more that we can do with public television to solve the problem of lack of public concern or lack of public interest in these areas?

Dr. SCALETTI. Senator Bingaman, what you say is true.

The public television is co-owned by the Albuquerque Public Schools and the University of New Mexico and it has a mission for public television in education.

The interests are being renewed, at the present time.

Is Dr. Martinez in the audience?

[No longer present.]

Dr. Martinez was here earlier and he would have been appropriate to answer your question because the interest is being renewed in utilizing public television and cable television to try to reach out in terms of reaching more people by that name.

Senator BINGAMAN. Just to sort of emphasize that, I would say, the first time I heard of Dr. Begay was in the Nova program, which describes his own amazing, outstanding career. I think that that kind of message particularly his message, to students of an Indian background is a vital thing to get out to them at an age when they are making decisions as to career choices. He is a role model that any Navajo or Indian student should be well-aware of in deciding whether or not to pursue a career in science and math.

I think the public television is the best way to get that done that I know of.

Senator DOMENICI. Yes, Dr. Muller.

Dr. MULLER. Could I make one other comment?

Senator DOMENICI. Sure.

TEACHERS COULD WORK IN INDUSTRY

Dr. MULLER. This is a contribution a little bit off.

I have thought, earlier on, there was some discussion about how industry could support this effort in science education. I would like to suggest the possibility of looking into the programs that would encourage your high school and elementary school teachers who were interested in science or were teaching sciences, to work in industry, either in the summers or even as a part-time job and encourage the actual teachers that are doing it to keep their foot in the door in the research aspect because that is the most exciting stuff and that is the kind of thing they can take back to the classroom.

Senator DOMENICI. Dr. Griego, when did you get interested in math?

Dr. GRIEGO. I am a Sputnik baby. I graduated from Albuquerque High in 1957. That is the year that Sputnik was sent up and there was this big push to catch up with the Russians.

Now, earlier, in the 9th grade and 7th and 8th grade, I had gotten interested in astronomy because my mother, who was interested in astrology, bought me a little book on astronomy thinking that it had to do with the same sort of thing she was interested in. I learned all about solar systems and stars and things and it got me interested in science and I continued my interest. I got a big push from the Sputnik crisis, I became a National Science Foundation fellow and that is why I support the NSF so much, because I would not be here today without the NSF.

AIDED BY INSPIRED TEACHERS

But I had some inspired teachers along the way at Albuquerque High. I had Madge Childry, who taught hordes of students mathematics at Albuquerque High. I then went on to the university, and here I am.

Senator DOMENICI. Did you, in your explanation of your math department, when you headed it, did you mean something very similar to what Dr. Muller was talking about?

Mr. GRIEGO. Yes, sir. I think that science education has a fairly low status in the scientific community and I think that is why I said that the science education has been an orphan child at NSF. It does not get the sort of support from the National Science Board that I think it should. Because it does not have that sort of advocacy and support, I think it has fallen by the wayside. I think that needs to be changed.

Senator DOMENICI. Are you a mathematician or a teacher?

Dr. GRIEGO. [Laughs.]

Senator DOMENICI. Have you changed any over the last 8, 10, 12 years, in terms of how you would answer that question?

Dr. GRIEGO. Well, I consider myself an educator. I have always wanted to be imbedded in the educational system and process and to utilize universities and institutions to better the conditions of our people and basically, I am a New Mexican, I think. I am a peasant.

Senator DOMENICI. OK. Next time, I will ask you, "Are you a New Mexico scientist or a New Mexican mathematician or teacher?" But I will not have the chance for awhile.

Let me say to Senator Bingaman, I have been told that our visitors from Santa Fe may very well have to leave because of their time schedule. I think this might be an appropriate time, if you are on that kind of schedule.

We will thank you and excuse you while we change panels.

We do appreciate your coming. We hope that you, from my standpoint, do not think that our effort in this regard is intended in any way to supplant the very fundamental job that you all have in providing the resources for education in New Mexico.

I certainly do not look at this role or the National Government's role in that regard. In this process I hope that we can exchange

views with you as to what you might be doing in this area by way of the legislation that you propose and in appropriations that you enact so that wherever we can, we are in sync and in harmony. I thank you again for coming and for your patience in being with us this afternoon.

Thank you very much.

Representative Vigil. Thank you very much for inviting us.

Senator DOMENICI. See you shortly.

[The third panel of witnesses is excused.]

[New Mexico Senator Tim Jennings and New Mexico Representative Sam Vigil depart.]

Senator DOMENICI. Could we have order and have our next panel, please? We are going to try to finish here by 5 o'clock.

Dr. John Cantwell, school board member, Albuquerque Public Schools; Dr. Frank Sanchez, superintendent of schools, Albuquerque Public Schools; Father Andrews, president of the New Mexico Association for Non-Public Schools; Edward Gaussoin, executive director of the New Mexico Education Association; Dr. James P. Miller, superintendent of schools, Santa Fe Public Schools. And I understand it is Edmund, not Edward and I apologize for that. I can do better with the first name than I can the last. It is Edmund Gaussoin.

Shall we proceed? John, we welcome you here.

STATEMENT OF DR. JOHN A. CANTWELL, SCHOOL BOARD CHAIRMAN, ALBUQUERQUE PUBLIC SCHOOLS

Dr. CANTWELL. Thank you, Senator Domenici. Senator Bingaman. I have submitted a statement for the record so I am just going to highlight my points.

Senate DOMENICI. All right.

PREPARED STATEMENT OF DR. JOHN A. CANTWELL

Senator Domenici, members of the committee, and its staff. I genuinely appreciate the opportunity to discuss this proposed legislation. It should be understood that while I am a member of the Albuquerque Public Schools Board of Education the views expressed here are my own and do not represent the official position of the Board or the personal perspectives of other members of the Board.

My comments will be directed to some observations about the three Titles of the proposed legislation, some notes concerning how the Albuquerque Public School system is addressing some issues related to the legislation, and finally some summary thoughts.

As you have said repeatedly, the shortage of qualified elementary and secondary teachers in math and science is weakening our educational system and setting the stage for a potentially catastrophic undermining of the nation's economy and national security. In the January 21, 1983 issue of Science, an article by Toshio Shishido, Vice-President of the University of Japan outlines the history of Japanese industrial and technological growth. Shishido attributes Japan's current technological strength to ". . . the education of the general population and government initiative and support." It seems to me that the proposed legislation goes to the heart of both issues in our own situation. I will attempt to illustrate this in the following remarks.

TITLE 1. CONGRESSIONAL SCIENCE AND MATHEMATICS EDUCATION MERIT SCHOLARSHP AND TEACHING AWARDS

The idea of a national program of merit scholarships to encourage the very best candidates possible to enter the teaching profession as math and science teachers has considerable merit. It is my personal view that teaching in general is no longer considered the most important profession—when in fact it is perhaps the most criti-

cal endeavor we entrust to others. Whether for such reasons as low salaries or the deterioration in public support of education teaching is no longer a very attractive field. It is extremely important that as a nation we renew our commitment to attracting and retaining our most dedicated and competent citizens to the teaching profession.

I have two suggestions concerning this section of the legislation. It is noted ". . . students receiving these scholarships will make a public commitment to teach. . . ." It is my personal belief that something beyond simply a "commitment" may be necessary to insure that scholarship recipients actually teach for the minimum three years outlined in the legislation. While repayment of the scholarship (should the recipient not enter teaching) may not be appropriate, some positive incentive for actually executing the commitment may be appropriate. Perhaps an additional grant of $1,500 might be awarded at the end of the three years if the three year commitment is honored. This could be used for graduate work, independent research or other forms of professional renewal and updating.

Concerning the $5,000 and $10,000 awards for experienced teachers, it might be helpful to insure involvement of local districts in this recognition. This might be done through a provision which would require the district to grant a 6–12 month sabbatical to the recipient. This would insure local recognition and involvement as well as give a recipient time for professional renewal.

TITLE II. SPECIFICATIONS FOR COMMISSION

The scholarship and award provisions in Title I are means for attracting and hopefully retaining math and science teachers. Of perhaps equal or greater importance are the State Commissions on Mathematic and Scientific Excellence outlined in the legislation. They are important for a number of reasons. They will provide a mechanism for assessing and bringing to the attention of the general public, legislators, school boards and others the actual conditions of science and math education in the states. In the Sputnik era when a national priority developed to "catch up with the Russians" we perhaps overlooked the need to develop a sustained public awareness that math and science are far more than a high school or college course we struggled with—and that indeed the application of math and science by a general population which is literate in both the content and processes of these disciplines may be essential for individual and national economic independence and prosperity. The Commissions can help in building the awareness needed to generate broad based understanding and action.

The proposed legislation might benefit from a couple of modifications in this section concerning Commission membership and responsibilities. State universities and colleges have a key role to play in science and math teacher preparation. A representative from these institutions (at the University Provost and Deans level) could provide added perspective and direction to a Commission's work. Further, the number of science and math teachers included in the proposed membership would only be two out of the total seven proposed members. Our goal should be to attempt to influence influence the heart of math and science excellence—the practices of the classroom teacher. To do this the voice of teachers must be strengthened in the Commissions. I would recommend that the number of teachers be increased to a total of four.

It is understood that the responsibilities outlined for the State Commissions were intended to be illustrative and not exhaustive. Nevertheless, the items listed in the legislation will be used as departure points as the Commissions begin their work. This being the case, it might be well to include among the proposed tasks for the Commissions two additional items. The Commissions might find it most challenging to review programs of study and course requirements at the elementary and secondary level in their states in relation to some generally agreed upon (if that is possible!) definition of what will constitute math and science literacy in the 1990s and the year 2000. Likewise, the Commissions might well collect and analyze specific information about entery and retention rates for math and science teachers in the school districts of their states.

TITLE III. BLOCK GRANT FOR THE IMPROVEMENT OF MATH AND SCIENCE EDUCATION

I am not familiar with the technicalities of the operation of Block Grants, but I do sense that local school districts do not always feel that their priorities and wishes are being addressed by block grant decision-making bodies which must prioritize projects and allocate funds. The language as proposed does appear to require the State Departments to use the Block Grant funds to ". . . develop and implement a comprehensive program, consistent with the goals and priorities of the State Com-

missions on Excellence . . ." As long as this provision is adhered to, there should be no difficulties but it may be wise to insure that the state superintendent of public instruction in each state is accountable to the State Commissions who are charged with oversight concerning this matter.

I am concerned about one other provision in this section—the prospect that as much as 40 percent of a total state allocation could be used for the purchase of equipment. My experience with federal education programs suggests that this may be too high—hardware is relatively easy to purchase. Carefully spending funds to influence the substance and quality of what is going on in teaching and learning processes is much more difficult; yet it is these processes which need enhancement and growth. This is not to say that there is not a need for substantial expenditures on equipment but if the funds are limited—and it seems to me that $200 million spread among 50 states and the territories is indeed a limited amount—then 80 percent or so of the funds should be targeted on expenditures which improve the teaching and learning transaction.

PERTINENT ISSUES—MATH AND SCIENCE IN THE ALBUQUERQUE PUBLIC SCHOOLS

The Administration and Board of the Albuquerque Public Schools recognize many of the issues highlighted by the proposed legislation. As an illustration the following are developments over the past twelve months:

The Administration and Board are considering adding an additional year of science for high school graduation—two years of mathematics are already required.

Planning is underway to provide mechanisms to recertify teachers who are in over supplied fields (such as home economics and social studies) in math and science.

The Board recently directed that the District's sabbatical program for the year 1983-84 be used exclusively for math and science teachers. This modest program for five full-time teachers is intended as a source of professional growth, recognition of strong performance, and an attempt to insure the continuing commitment of our best teachers.

The Board developed a resolution and included among its 1983 State Legislative priorities state funding of an incentive loan program for math and science teachers similar to that which you have proposed at the federal level.

The voters of this District passed a $65 million bond issue on February 1, 1983 which will provide funds for science and computer education related equipment and facilities costing approximately $8,500,000.

SUMMARY THOUGHT

In summary, I believe the proposed legislation addresses the development and retention of math and science teachers as well as encourages the states to seriously examine the status of math and science education and take appropriate action. I am sure there will be many pressures to modify and expand the proposed legislation. In the midst of these pressures I hope:

1. Any reduction in the proposed funding levels will be strongly resisted—the proposed amounts, while reasonable, are hardly generous given the magnitude of the problem.

2. That should higher education interests request inclusion of provisions applicable to them that separate legislation will be developed. One of the major strength of this proposal is the focus on the elementary and secondary level. In fact, if we are to seriously impact the scientific and math literacy issue for the general population most of the effort might be best focused at the elementary level in the early years of the program.

3. That serious consideration will be given to expanding the provisions of this legislation to cover not only math and science but computer science as well. When Time Magazine's Man of the Year turns out to be the computer that would seem to be a signal of how profound an impact this technology is and increasingly will have on our lives. Certainly the computer is a tool to be used in math and science but it has far larger implications as a subject matter discipline which requires the same attention as math and science.

Senator, again I want to thank you for asking for my thoughts—your proposal is an extremely important one. The views expressed here are, as I said, my own but my awareness and understanding of these issues has been substantially influenced by several key staff members of the Albuquerque Public Schools—Hilde Howden (District Director of Math Instruction), Mary Ann Esquibel (District Director of Science Instruction) and Mary Beavis (former Chairman of the Science Department at Manzano High School and now Staff Coordinator of Federal Programs)—who have

also appeared here today. I hope you and your staff will call on these individuals for further critique and review as needed—I'm sure they will be as generous and thoughtful with members of your staff as they have been with me. They represent the kind of leadership and quality that your legislation is designed to encourage and recognize.

Dr. CANTWELL. My remarks here this afternoon are really my own views, very much my own views in some sense and are not the official position of the board, although I suspect many members share them.

PROVISIONS OF THE BILL HIGHLIGHTED

I would like to highlight a couple of things this afternoon, on some of the specific provisions of the legislation, some thoughts I have, and some things that we are doing in APS as we question whether we are doing anything at the local level about these concerns.

Lastly, I have some thoughts and some concerns about this legislation as it passes through the process in the Congress.

Concerning title I and the merit scholarships and teaching awards, there is no question in my mind that we desperately need that kind of legislation at the Federal level.

To do so is to say once again that teaching is important in this country and not just teaching in math and science, but that we are concerned about it and concerned for all the reasons we have talked about this afternoon.

With respect to the scholarships, I am a bit concerned about the language that reads that the individual receiving the scholarship simply need only make a public commitment to teach. You touched on that issue relative to the forgiveable provisions.

It seems to me that it might be worth exploring, whether there are some positive incentives relative to the insuring of the commitment. One might do that through, at the end of the 3-year period, an additional grant of some amount for further study or upgrading of the formal training.

Concerning the grants to the experienced individuals, it seems to me, that this is an opportunity for local school districts, perhaps, to match that federal commitment via a sabbatical, or some other useful way to use that $5,000 or $10,000 in the continuing upgrading of the capabilities. I think that kind of match, if you will, on the part of the local districts is not an unreasonable one and ought to be explored with the local education agencies.

In title II specifications for the commission, I think that specifically addresses Senator Bingaman's early comment relative to, "What are we going to do about long-term public awareness? When money quits flowing, indeed, are there going to be some instrumentalities or mechanisms in place?"

That would be my hope for those kinds of commissions. I think this bill begins to start that process so that the conditions at the State and local level are, in fact, addressed and surfaced and there is then long-term continuity of that kind of concern.

COMMISSION MEMBERSHIP

I am concerned about commission membership. As I read the language in the legislation, seven members are proposed, only two of which would be teachers. Indeed, I think, if we want to go to the heart of the teaching-learning process, then the representation and the voice of the teacher needs to be strengthened in those commissions, perhaps even at the expense of broadening the commission's general base.

I also think, that State universities, especially the teaching-trainer portions of those institutions need to be represented on those commissions, perhaps at the provost or the dean level because they have a key role relative to this whole process.

Senator DOMENICI. Which the last panel obviously highlighted.

Dr. CANTWELL. Yes, exactly. And I would reinforce that. I know that the priorities that are laid out in this legislation are not intended to be exhaustive, but will be used as reference points by the commissions.

It seems to me it would be useful to have the commission look at course work and the requirements in their respective States relative to what should math and science literacy be in the year 2000.

Then they should really begin to address those standards, not only in terms where they are at that point, but whether and how they want to move toward them.

Relative to the block grants, I do not have any particular expertise relative to the administration but I do think that a closer link to insure that the State superintendent really is accountable to the commission is important. That is implied in the bill; language, but I suspect that making it more explicit would be helpful. I am sure that Mr. Delayo would be helpful to you in insuring that that language was not intrusive. I, for one, would be more comfortable if those commissions really thought that they had oversight responsibilities and a close link with the State superintendent relative to the execution of the block grant and the commission plan.

REDUCE FUNDS FOR EQUIPMENT

Another area of concern in title III is the provision that 40 percent of the grant money could be used for the purchase of equipment. Having had some experience with Federal grants, I think that ought to be closely examined.

It is easy to go buy equipment. Not that there are not equipment needs, but, indeed, if we want to influence teaching and learning transactions with these funds, then I would reduce that 40-percent possibility to somewhere in the 20- to 25-percent range, at least for the early years.

Relative to some things that we are doing in APS, let me note these for you. The administration and the board are considering adding an additional year of science for high school graduation, 2 years of mathematics are already required.

The board recently directed that the district sabbatical program, which is a very modest program for five teachers a year, and gives them, in effect, a leave of absence. Next year for 1983–1984, these sabbaticals will be devoted exclusively to math and science teachers.

FORGIVABLE INCENTIVE LOAN PROGRAM

The Board also developed a resolution and included among its 1983 State legislative priorities, State funding for an incentive loan program of the forgiveable type. We have asked Frank to take that to Santa Fe and see if, indeed,we cannot begin to surface that as an issue. It is unlikely that it might pass this session. Maybe it is a beginning.

Finally, last Tuesday the voters of this district approved a $65 million bond issue, $8.5 million of which will be used for computer education and science-related facilities.

That is a substantial investment.

Some summary thoughts as this legislation passes through the process. I think you should do everything you can to resist a reduction in the proposed spending level. I do not think it is an overly generous amount and it will only give us a start, given the distribution across 50 States and territories.

There will also be some pressure, I am sure, to include provisions that are applicable to higher education in this provision. I would resist that also. I think they need separate legislation on issues that are germane.

Indeed, if we want to increase the general literacy and awareness in the population that has been described this afternoon, focusing the resources at the elementary level, as has been suggested by a number of people may even merit consideration.

Last, as Dr. Resta indicated to you, I think that everywhere it reads "math and science," indeed, it could productively read, "math, science, and computer science" for all of the reasons that Paul talked about.

It will not only be a tool in math and science but it is a discipline unto itself that you need to begin to say to teachers, "It merits study and your attention and it is worthy of the language in this bill."

Lastly, I want to thank you for the close work that you have obviously done with the teachers of this district. It is the kind of teachers such as Mary Beavis that we are concerned about holding and attracting into this business and those are the kinds of teachers that make science, we think, in this district what it is.

Thank you.

Senator DOMENICI. Thank you.

Frank.

STATEMENT OF DR. FRANK SANCHEZ, SUPERINTENDENT OF SCHOOLS, ALBEQUERQUE PUBLIC SCHOOLS

Dr. SANCHEZ. Thank you, Senator Domenici.

Senator BINGAMAN.

I am a little antsy today. The last time that I testified before a Senate committee, it was a Senate Appropriations subcommittee, headed by a State Senator, namely, Senator Montoya. I testified on bilingual education. It was very comfortable. I felt like I was in good company.

After the committee turned me every way but right, I came out wondering whether I ought to testify again before any Senate sub-

committee or committees. However, I am really appreciative to be able to share some thoughts with you today.

Obviously, as I indicated to Joe earlier, I prepared six different papers for testimony today and discarded all six of them. They have already been covered. But I do have some general comments relative to your bill.

First of all, let me say that is very clear, it is very simple. It is something new from my perspective from my work in this district as director of Federal programs over 3 or 4 years during which I became very well acquainted with Federal legislation.

I hope that it does not change very much. It is flexible.

But let me give you three thoughts I have. I believe that the Federal Government has a role in public education in this country. At the same time, I think that the Federal Government has to set priorities. By your presenting this bill, you have done that. You have focused the national attention on the crisis and therefore, the Federal Government is taking leadership in terms of alleviating that crisis.

HOLD FUNDING LEVEL

But you have gone beyond that by putting some money in it. I would have to agree with Dr. Cantwell that I would hope that the funding level does not drop from the $200 million, particularly in the block grant. Perhaps as we go along, while I know that there are many organizations that are asking for more money, that that can be improved as we prove ourselves. Sometimes when you get too much, you have a tendency to fritter away some of those dollars indiscriminately.

I think that the other thing that this bill does to recognize that this Nation has a decentralized educational system. It is not a centralized system like Japan or West Germany or Russia or others, but rather a decentralized system.

DECENTRALIZED SYSTEM HAS WORKED WELL

Education is really a function of the States.

Your bill actually strengthens that system by allocating the funds to the State and the local education agencies because we are the ones that are in the trenches. We are the ones that need the help.

I get awfully antsy, and this is a side remark, when we are compared to Japan, to West Germany. It is very easy for a minister of education in a centralized system to call all the shots. I think that the decentralized system in this country has served us well in the past and I am sure that it will serve us well in the future. I am very pleased that your bill strengthens that system in the way it allocates funds.

I am also very pleased that the bill recognizes that the teacher, student, and subject matter triangle exists. That is really education. It is the simplest form and the most successful educational practice in this country, where these three factors come together, the teacher, the student and the subject matter.

Your bill does provide for attracting qualified people, the right people into the profession, for upgrading the status of those that

are already in there and also for developing rigorous curricular matter.

Now, I have just two or three other comments I would like to reinforce. Dr. Cantwell and I talked about this. I would like to see at least two more teachers added to the State commission. I think that they are the ones that are really in the classroom and it is their views that we need to have.

SUPPORTS BLOCK GRANTS

You need to know that I am very much in support of block grants and I am glad that is the way it was set up because the flexibility then comes at the State and local level, where it ought to be.

I am also pleased with the provision in the bill in which local allocations from the State level on down to the LEA's would take into consideration a higher per pupil allocation in those districts with children whose cost of education is higher than the average, those having large groups of title I youngsters and minorities, et cetera.

Again, I am very pleased. I had hoped that Dr. Dacey would mention it this morning or earlier this afternoon. We have initiated, at least on a preliminary basis, discussions on utilizing the scientific community as part of the total educational component here in the Albuquerque public schools. He and I will be sitting down very shortly to look at not only the retired teachers but retired scientists from his community, Sandia Labs and/or some of his personnel on board in terms of how they can assist us in our endeavors.

Thank you.

Senator DOMENICI. Thank you, Frank.

I would really be remiss, Frank, even though it is certainly not my business and it is of a lot of people here, I would be remiss if I did not congratulate you on the splendid job you are doing. I am certain that, not too many months back when you got the job you now hold, that there were a lot of skeptics.

I think you have done a magnificent job and I compliment you. I mean that honestly. Of course, I have known you for so long, I would not have been a skeptic regardless of what they asked you to do but I genuinely compliment you.

Father, we are delighted to have you here.

STATEMENT OF REV. DENNIS M. ANDREWS, PRESIDENT, NEW MEXICO ASSOCIATION FOR NON-PUBLIC SCHOOLS

Father ANDREWS. Thank you, Senator.

Senator Domenici and Senator Bingaman, I would like to thank you for allowing me this opportunity to speak to you on behalf of the New Mexico Association of Non-Public Schools, which represents 63 nonpublic schools in the State of New Mexico with an enrollment of 15,030 students.

The New Mexico nonpublic schools serve more than 20,000 students in this State, which represents a figure of 8 percent of the statewide K through 12 school enrollment.

Our needs in the area of math and science are great. However, in particular, I would have to state that our needs would involve teacher certification and staff development, resource centers, instructional materials, science equipment and computer hardware, software and in-service training for our staffs.

Title I of your bill, Senator, addresses the need for more students to become teachers in the areas of math and science but I am sure, as you have heard from testimony, we are facing a problem.

SCHOOLS COMPETING WITH INDUSTRY FOR PEOPLE

That problem is, our society does not hold teachers in very high esteem. In addition, we are competing with industry to attract young people to go into teaching math and science.

The substantial scholarships with a commitment to teaching may provide an incentive for our talented young people to pursue teaching careers in math and science.

The teacher awards as stated in title I, presented with an appropriate, highly visible publicity, should add prestige to the teaching profession and may help us in keeping our young math and science teachers in our schools.

Most teachers in the nonpublic schools must hold certificates endorsed in a number of teaching areas. Stipends to permit teachers the opportunity of returning to school to gain those endorsements in the various areas of science and in mathematics would be of great benefit to the nonpublic schools.

As we all know, technology is moving more rapidly than most of us can comprehend. Science and math teachers are particularly hardpressed to keep abreast of the latest developments for curriculum, especially with respect to relevant content, appropriate instructional materials and enrichment opportunities, but also in order to act as advisers to their students, and to encourage those students to pursue careers in math and science and as well as needs in other careers.

CHANGE "INSERVICE TRAINING" TO "STAFF DEVELOPMENT"

Staff development activities, workshops, field trips and internships should be a part of the authorized use of title III funds. Because of this fact, I would strongly recommend that in section 5-(E) of your summary of your bill, that the term "Inservice training" be changed to "Staff development."

This will allow us to include all of our staff members in this area.

Another important aspect of the bill permits resource and enrichment centers to be made available to students and teachers which would be of great benefit to the public schools.

Instructional materials change rapidly, particularly in the area of science. Funds for the nonpublic schools to purchase instructional materials are an essential part of the authorized use of the title III funds.

Equipment is essential in providing students with a solid understanding of scientific principles. But, unlike the public schools, we do not have the ability to pass a bonding issue.

Therefore, the ability to purchase equipment with title III funds will be of considerable assistance to the nonpublic schools.

Finally, the computer is becoming very pervasive in our society. Its use cannot be simply confined to math and science. The block grant funds for the purchase of computer hardware and software and for the inservice training of teachers and administrators in the use of the computers in all those curricular areas, again, will be of benefit to students as well as to teachers.

Senator Domenici, the nonpublic schools in New Mexico are very, very pleased that you have included recognition of the nonpublic schools in your math and science bill.

The summary of the bill which you sent me, however, does not include, in title III, a specific requirement for nonpublic school participation with the local public school districts in the block grants allocations.

If such a provision is not in the bill, I would strongly recommend that one be added, perhaps similar to the arrangements in chapter 2 of the Education Consolidation and Improvement Act.

In summary, the greatest needs of the public school in science and math are teacher certification and staff development, resource centers, instructional materials, science equipment, computer hardware, software and inservice training. We share these needs. These areas you have addressed in your bill.

I would like to thank you for this opportunity of speaking to you on behalf of our association. As an aside, I am sure you are aware, I am also principal of St. Pius the Tenth High School. I am very proud to say that we have a very dedicated staff of science and math teachers. This is evident from the fact that those students are scoring anywhere from four to five points above the national average in the areas of math and science on the ACT's.

We also have students who are interested in math and science. Where four-fifths of those students will take 3 years of science, probably three-quarters of those students will pursue 4 years in math.

One of our students by the name of Adriana Martinez, because of her interest in science, and because of the dedication of that staff, has done extremely well in the local, regional, state and national science levels. She is recognized for this.

As a principal, I am always faced with, "We need this. We need that." Because of budgetary requirements, oftentimes I have to say no to the resources they need.

Your bill now provides me that opportunity to provide those students and staff with those resources and for this, I am grateful.

Thank you.

Senator DOMENICI. Thank you very much, Father.

The language that we have in the bill so far, and we will listen to your further suggestion, is very similar to the language that the distinguished chairman in the House Committee on the Education Committee, Congressman Perkins, has in title I of the compensatory education bill.

We will look at the other suggestion and certainly be in touch with you with regard to it.

[The full prepared statement of Father Andrews follows:]

STATEMENT OF NEW MEXICO ASSOCIATION OF NONPUBLIC SCHOOLS, PRESENTED BY REV. DENNIS M. ANDREWS, C.S.B., PRESIDENT

Senator Domenici, members of the committee, thank you for the opportunity to address the Committee, on behalf of the New Mexico Association of Nonpublic Schools. The Association represents 63 nonpublic schools in the state with an enrollment of 15,030 students.

The New Mexico nonpublic schools serve more than 20,000 students. This represents 8 percent of the statewide K-12 school enrollment.

Most of our nonpublic schools are small. The average enrollment is 120 students. Because of their small size, nonpublic schools share many problems with small public schools in New Mexico. Nineteen of the 89 public school districts (that's 21 percent of the public school districts) have fewer than 300 students. It would be presumptuous of me to speak for the small public schools, but I want to note that the nonpublic schools are similar, in some respects, to small public schools, and I note that there is no one on the schedule of witnesses who represents small public schools.

The greatest needs in nonpublic schools in the areas of science and mathematics are: (1) teacher certification and staff development; (2) resource centers; (3) instructional equipment; and (4) science equipment; and (5) computer hardware, software, and inservice training.

Title I of Senator Domenici's bill addresses the need for more students to pursue teaching careers in math and science. Our society does not hold teachers in high esteem; persons with math and science propensities tend toward careers in the private sector. The scholarships with a commitment to teaching may provide an incentive for some of our talented young people to pursue teaching careers in math and science.

The teacher awards of Title I, presented with appropriate, highlyvisible publicity, should add prestige to the teaching profession and may helop in keeping our young math and science teachers in our schools.

Most teachers in nonpublic schools must hold certificates endorsed in a number of teaching areas. Stipends to permit teachers the opportunity of returning to school to gain endorsements in various areas of science and in mathematics will be a boon to the nonpublic schools.

Technology is moving more rapidly than most of us can comprehend. Science and math teachers are particularly hard pressed to keep abreast of the latest developments for curriculum purposes—relevant content, appropriate instructional materials, enrichment opportunities—but also in order to act as advisers to their students regarding careers in math and science and the need for these skills in other careers. Staff development activities—workshops, field trips, and internships—should be a part of the authorized use of Title III funds. In this regard, I would recommend that in Section V E of the summary of the bill, the term "in-service training" be changed to "staff development."

An important aspect of the bill permits resource and enrichment centers available to students and teachers which will be of great benefit to nonpublic schools as well.

Instructional materials change rapidly, particularly in science. Funds for the nonpublic schools to purchase instrcutional materials are an essential part of the authorized use of Title III funds.

Equipment is esential to providing students with a solid understanding of scientific principles. Unlike public schools, however, nonpublic schools have no bonding capacity. Ability to purchase equipment with Title III funds will be of considerable assistance to the nonpublic schools.

Finally, the computer is becoming pervasive in our society—its use in not confined to math and science. Block grant funds for the purchase of computer hardware and software, and for the in-service training of teachers and administrators in the use of computers in all curricular areas will be of great benefit to the students attending nonpublic schools.

Senator Domenici, the nonpublic schools on New Mexico are very pleased that you have included recognition of nonpublic schools in your Math and Science Excellence Bill. The summary of the bill which you sent me, however, does not include in Title III a particular requirement for nonpublic school participation as to how block grant funds will be allocated with the local public school districts. If such a provision is not in the bill, I recommend that one be added, perhaps similar to the arrangements in Chapter 2 of the Education Consolidation and Improvement Act.

In summary, the greatest needs of the nonpublic schools in science and math are teacher certification and staff development; resource centers; instructional materi-

als; science equipment; and computer hardware, software, and in-service training. These areas are addressed in the senator's bill.

We suggest, however, that Title III require participation of the nonpublic schools with the public schools; that the references to "in-service training" be changed to "staff development," and that teachers in all areas and administrators as well be permitted to participate in computer training programs.

Thank you. I would be pleased to respond to any questions you might have.

Senator DOMENICI. Edmund, you can proceed.

STATEMENT OF EDMUND GAUSSOIN, EXECUTIVE DIRECTOR, NEW MEXICO NATIONAL EDUCATION ASSOCIATION

Mr. GAUSSOIN. Thank you very much, Senator Domenici and Senator Bingaman. I appreciate the opportunity to be here today. I would like to say that I am here and I accepted the invitation, not as much in my role as the executive director of NEA New Mexico, but more in my interest in science and math teaching and in the public schools in general.

Therefore, I would like to give you the brief background story. I taught in New Mexico in the public schools for 22 years and I started my teaching career in September 1945 in a New Mexico public school.

I was a teacher of physics and chemistry. I was teaching when Sputnik opened the eyes of our country to the need of a more comprehensive curriculum in math and science and Congress passed legislation at that time that gave teachers the opportunity to upgrade their skills in teaching math and science. Grants were provided to pay tuition and expenses for going back to study and becoming more skilled as teachers. That program was a success.

I participated in it for several years and I can report that my ability to turn the students on and get them more excited in science improved. I think the programs were good and there is strong evidence that math and science instruction improved, for a time.

TEACHERS LEAVE PROFESSION BECAUSE OF MONEY

I taught in New Mexico schools for 16 years. Then I moved to California and I taught in California schools for 6 years. I then left my chosen career and accepted a staff position with an NEA affiliate and I have been a staff member with NEA ever since.

Now, there are two changes in this brief review of my background that I believe are significant and to understand the significance I want the committee to know that I think the classroom teacher is and was the most important professional that exists in a free society.

The first change was my move from New Mexico to California.

Why would anyone want to move from New Mexico to go to California? Teaching in New Mexico is just as important as teaching in California.

The answer was money. At the time, I was earning $5,900 as a New Mexico teacher on the 16th step of the salary schedule. The position in California paid $11,000 for a teacher with my qualifications on the 6th step of their salary schedule.

Six years later I left the classroom staff for a staff position for the same reason. Money. I had to earn more money in order to

make sure my six children were given the opportunity for a college education. I would have preferred to stay a classroom teacher.

My story is no different than that of many teachers. Gifted, creative teachers cannot afford to remain in the teaching profession. And, the problem is getting worse.

I met a young lady on a flight to Omaha, Nebr., just 2 weeks ago. This young lady was a graduate of Carlsbad High School in 1972. She was also a graduate of New Mexico State University. She majored in electronics and mathematics. She was employed as the regional manager for Texas Instruments Computer Division.

She told me that she employed many people to market the Texas Instruments products. Part of them were part time and many of them were full time. She said that she had found out that the best source of employees was teachers.

I asked her if she hired math and science teachers. She said she preferred math and science teachers, but that almost any teacher turned out to be a good employee. She also stated that she had no problem in hiring the most qualified because the company paid so much better than the schools did.

This is only one example. There are many others, insurance companies, utilities companies, book companies are just a few of the others that recruit teachers as employees.

These teachers that are recruited are the talented, the gifted and the creative. They frequently are the best. Many of the companies want the math and science teachers and they get them because they pay more.

And as an aside, Senator Domenici, one of the weaknesses that I find in your bill is the 3 years, 3 years of commitment and after that, industry gets another well-trained scientist. And I think that is tragic.

Senator DOMENICI. I know but I do not want to create servitude. [Laughter.]

Mr. GAUSSOIN. I did not have a correction. I just had a concern.

PRIVATE SECTOR HAS ADVANCEMENT POSSIBILITIES

Private sector employment has other features that attract teachers. One I have already explained is the higher salary. The second is the opportunity for advancement. The third is the opportunity to attend college or university at company expense with no loss in salary and no loss in time. The fourth is the recognition for doing a good job.

There are other incentives. Teaching is usually a terminal position. The children change every year but the problems seem to grow every year. There is little chance for advancement. Advanced study, including travel, away from home expense, and tuition are right out of the teacher's pay check.

It is difficult in smaller school districts to plan and schedule a workshop or in-service training that is appropriate or fits the needs of enough teachers to make it worthwhile and cost effective.

WHY FREE PUBLIC EDUCATION

Before going on, I would like to suggest that there needs to be a determination as to why we have free public schools. There are

many who will contend that public schools exist to provide education to the young people of this country and certainly we can agree that is a function of public schools.

However, I believe the real reason that free public schools exist is to guarantee the future of our free society.

Educated citizens are more employable than the uneducated. Unemployed citizens cannot contribute to the cost of maintaining a free society. Free public schools as a total entity are a benefit to society and for that reason, I believe that the Federal Government has a distinctive and an important role in the maintenance and the operation of the schools.

I clearly realize that the focus of this study is to address a concern generated by a growing shortage of math and science teachers. As a former science teacher and a strong believer that the United States must recover its position in the world of technology, I applaud the concern.

I want to suggest, however, that the shortage of science and math teachers is just a symptom of a much larger problem and that to focus a solution on correcting the math and science problem will escalate the total problem.

Preparing young people to go out and serve society is a long-term process. Formally, it starts with kindergarten and moves through the K and 12 system and then sometimes on to college.

The foundation is built in the early years. Teaching in elementary schools is especially important for disciplines that require the understanding of concept as well as process.

My request is that you broaden your study, help States find ways to make the teaching profession more attractive to the creative and talented and the gifted, help universities find ways to help prospective teachers be skilled in stimulating students to want to learn; focus your attention on the assistance needed by the public school system as an entity.

Build help that has long-lasting results. Make good public schools and education your top priority.

I believe that good public schools are this country's first line of defense and they can be the solution to our economic problems.

Again, I appreciate very much the opportunity to be here.

Dr. MILLER. We are delighted to have you.

Senator DOMENICI. Thank you very much.

STATEMENT OF DR. JAMES P. MILLER, SUPERINTENDENT OF SCHOOLS, SANTA FE, N. MEX.

Dr. MILLER. Thank you, Senator Domenici. Let me thank you for bringing your colleague home. We are mighty proud to have Jeff Bingaman in the U.S. Senate and it is a pleasure to have him at least this close to the top of La Bajada Hill.

Senator BINGAMAN. I was up there until lunch.

Dr. MILLER. Were you? Good. Good.

Senator BINGAMAN. I am going back tonight.

Dr. MILLER. Good.

I will be brief. We support congressional actions and I would like to point out, this is simply another specific instance of the general but too-often ignored truth that the wealth and well-being of the

Nation is tied directly and inescapably to the work of the Nation's schools, from kindergarten through graduate school.

We are lucky in Santa Fe in having a community which makes the recruiting of teachers relatively easy. But even we are well-aware of the continuing and growing shortage of math and science teachers.

You will be glad to know that at the main campus division of Santa Fe High School we have had a substantial and positive change in the willingness of students to enroll in advanced elective courses in math and science.

We are having to offer more such sections despite a gradual and steady decline in overall enrollment at that campus. Moreover, in the past 3 years, science and engineering has become the leading career choice of all those students who take the American College Test at Santa Fe High School.

Now, here is the bad news. We do not believe that these favorable trends will result at all in increased numbers of math and science teachers. Our students know the difference in salaries for teaching as opposed to salaries paid for other work requiring math and science preparation.

In short, Senator, our students know how to count and they are counting and they are not going into teaching. This difference, moreover, in salaries, will grow.

State treasuries are empty across the Nation. In New Mexico we are faced with the immediate problem of a $115 million shortfall in revenues this fiscal year below expected expenditures, with highly uncertain prospects in at least the short-term future for an improvement in State revenues.

It seems highly likely that teachers' salaries will fall even further behind those paid in the expanding high-tech sector of our national economy.

SCHOLARSHIPS OFFERED IN BILL WELCOMED

We especially welcome, therefore, the encouragement to enter teaching which is embedded in the scholarship section of this proposed legislation. This will have a positive, long term impact on teacher supply.

I have mixed feelings about the notion of the teacher awards, partly because I have had no experience with anything comparable.

Now, Senator, in your position as head of the Budget Committee, I am sure you probably have in this bill about all the money you think you may be able to get for this legislation. If that is so, then I believe consideration should be given to reducing the award amounts so as to increase the number of awards possible.

Having as few as four awards annually statewide appears insufficient to generate the career interest you seek to stimulate.

BLOCK GRANTS ENDORSED

In closing, I would also endorse strongly the block grant program outlined in title III. During these years of fiscal shortfalls due to the recession, these targeted, authorized uses are the very kinds of things least likely to be funded by local budgets.

Our budgets at the local level will be strained to protect reasonable pupil-teacher ratios and to get even modest salary increases for teachers.

The block grant proposal will therefore bring very welcome help in strengthening our work in math and science teaching.

Thank you for inviting me.

Senator DOMENICI. Thank you very much.

Let me follow one line of questioning and yield to Senator Bingaman and then we will be through.

I think some of you know that I have a whole batch of children, eight, to be exact and three in and out of college almost all the time. I am blessed that none of them seem to want to quit at 4 years. I have one in law school besides the other three and even a married one who is trying to get a master's in history of art.

With the last three that are entering, I note as I look at catalogs—I have not had a lot of time to visit schools with them but I visited a couple—the first thing I notice is that the colleges of education are going down in size and emphasis, that is, within a university.

I don't think counseling has ever been very good at the college level in terms of telling young people where they might get a job. We always encourage them to go into fields that are exciting, even if the national statistics show there are not going to be any jobs.

ARE QUALIFIED TEACHERS GOING TO GET JOBS

But in education, they are right up to snuff, you know, they are telling all these kids, "Do not get in that college because there are not any teaching jobs." And I guess, from what I read, that is pretty much right. There are certainly not a lot of new openings.

So let me just ask all of you, since you have something to do with this, perhaps less on your part, what if we do this and we encourage a lot of young people to get into the education field specializing in math and science? And what if they are making some commitments because of, whether it is 3 years or bondage, what reaction are they going to get when they get out of there and come over to your school, Frank Sanchez, and ask for a job?

Or yours? You have a tough problem. You do not have an awful lot of vacancies, even though testimony is you may not have qualified math and science teachers.

What kind of response are they going to get from the school systems when they look for jobs?

Or, let me put it very bluntly, assume they are coming out far better-qualified and enthusiastic than what you have got. Are we going to hire them?

Dr. SANCHEZ. Senator, let me first start out by saying that with the turnover and attrition, that science and math are critical areas already of need. What we are doing in some cases is, we are actually retraining teachers in other fields into science and math.

Now, obviously, if you get specially well-qualified science and math teachers, you know, already ingrained in all the new math and science and they are up-to-date, obviously, they would have quite a leg up on getting jobs.

Now, while we project a decline in enrollment, it will not be long before it thing levels out, probably 1985-1986. Then it will start coming back up and at that time we will have need.

Also, there are increased requirements now, at least by our local university here in terms of getting into the university. They have increased their math and science requirements so we see the need for more teachers.

We do not think that we will ever shut the door on them, particularly math and science.

Senator DOMENICI. What do you think?

JOB AVAILABLE FOR SCIENCE AND MATH TEACHERS

Dr. MILLER. I feel sure that well-qualified people in math and science for many years to come will almost literally be able to choose their location for working in this Nation in the schools. The shortage is that severe and I think it is going to continue. I think the high-tech sector of our national economy is going to grow as a proportion of the work force in this Nation and there is going to be continuing demand to take those people away from us. So, we are in for a long siege, with this problem for, I would predict, at least the rest of this century.

Senator DOMENICI. Father.

Father ANDREWS. The number of applications you receive in the humanities is like this. The number of applications you receive in math and science is like that.

We are in dire straits right now. And I am hoping that this bill can pass so that the incentives will be there to start attracting those students. In the sense that they would be going into bondage to us, I guess my thought would be if they would get into the teaching profession they might find it very rewarding, very satisfying and want to stay.

Dr. MILLER. Senator, if I might, one of the wonderful areas I have been associated with, you heard earlier today about a network of women who are working to get girls into these careers?

Senator DOMENICI. Yes.

Dr. MILLER. I have been associated with that group and let me give some testimony for the Los Alamos schools. The chair of the math department at Los Alamos High School is a woman. She astonished us several years ago by pointing out, and this is wonderfully ironic, I think, that one of the communities that is having the greatest problem getting qualified math and science people is Los Alamos. Why? Because they are right down the street from the lab and year after year they bring in fine young qualified people and lose them immediately to the lab. There is that interesting and unique community struggling to keep people who are not emergency-certified people in math and science classroms.

Dr. CANTWELL. Senator, I think there is another element in that. There is an informal process going on and Jerry Madigan is here and Dr. David Bolton is here, the new dean of the college of education and Dean Chris Garcia and they are really talking about influencing the substance of what is different in the college of education, relative to math and science. It seems to me, until we begin to worry about that at the level those gentlemen are now worrying

about it, at the university, then we are going to continue to have the problem. That is why I am concerned that they be included and there be provisions so that their efforts are recognized and reinforced.

Without that kind of change in the structure of the university, then we are going to have the kind of problem in the teacher training dimension.

Senator DOMENICI. Well, my last question, Edmund, is, I do not ask you this today for you to give me an answer now but, I note that this bill or something like it has received very broad support by and from many organizations that are related to education.

NEA SUPPORT FOR BILL

The one that is missing at this point is NEA. You are here as their representative and I heard you loud and clear in terms of the broad goals of the NEA and the broad needs.

I did not hear anything with reference to support. I would hope that at some point in time, and this is not directed at you, that we would get a position.

I want to say right off, the part that might be addressed would be the $200 million in the block grant area.

I have heard some scuttlebutt that perhaps that will be the principal focus, that it is too small. It might be. But I do urge that while the NEA looks at this, bill, that you know, numbers for this kind of effort, we ought to have instead of $200 million, $2 billion.

WILL WORK HARD TO STAY EDUCATION BUDGET

I just hope there is the realism. Because we are going to work, at least this Senator is going to work very hard to keep the education budget in the other areas from getting cut.

In some areas it ought to be increased.

But you know, looking at the dimension of the other budgets, including title I, you know, to talk about billions for an effort in this area right off the bat, and I just hope that there is an understanding that that would be very difficult to accomplish.

The reason I mentioned Carl Perkins, and I do not know he said what he said. My staff tells me he did. But I think the fact that he sees a bill that I am cosponsoring and I am not even the main committee of jurisdiction, that has $200 million in block grants and has something very affirmative to say about it, does have some small indication of the dimension of the budget problem and the likelihood of getting significantly more.

So I merely place that on the agenda and I do not do it in any way to put you on the spot. I greatly appreciate what you said. As a matter of fact, you talked about your experience in teaching. I will give you my last one.

Sunday morning, here in Albuquerque, I did not have a car. Normally I do not have a car here. I was up on Louisiana and Gibson, where I frequently stay just for an overnight. And, I needed to go to Candlelaria and Rio Grande to visit my son who goes to law school.

TEACHER CAB DRIVER

I called a yellow cab and one drove up, Jeff, and I was amazed. I sat in the back seat and there was a handsome, beautiful, grey-haired lady driver, about 57, 58.

She looked back and said, "I have never seen someone like you in a cab. Are you who I think you are?"

I said, "I have no idea who you think I am. But if you think I am Pete Domenici, you are right."

She and I had a long conversation. The upshot of it is, that she is a full-time school teacher. She teaches special ed in Los Lunas. And she loves to drive a cab as a distraction and some kind of hobby.

She was tremendous. And she said that she kept the job even in winter months because she liked to keep open the option of doing that in the summertime.

I do not know what that story tells you. But I think it tells me something amazing about school teachers. I share that with you because it is something that is related to some of the comments that you made in your statement.

Mr. GAUSSOIN. Well, let me say, Senator, that I called Washington to see if they had taken a position on your bill prior to coming so I could give you the report. At the present time, they are supporting a bill called the American Defense Education Act.

Senator DOMENICI. Good.

Mr. GAUSSOIN. Which is coming on the other side, which has a lot of similar characteristics.

Senator DOMENICI. Yes.

Mr. GAUSSOIN. I asked them to review this bill with an eye to getting an endorsement on this side and trying to get some compromise out of it, if that is what we ended up with and I am going to take this to our own State committee that has not met since I got the invitation.

And in order to close this, Senator, you know you indicated that you got the job teaching science and math because of your baseball coaching ability.

An interesting facet is, the first school I taught in was in Springer. I was hired to teach chemistry and physics. Then about the middle of July, I get a call asking me to be up there early in August, when school started after Labor Day.

The Superintendent was a gentleman by the name of Wilfreth. And I said, "Mr. Wilfreth, why should I be there in the middle of July?" He says, "Because you are also the football and the basketball coach." [Laughter.]

I indicated to him, you know, that I did not sign up for coaching football and basketball and he said,

I have checked your record. You have an outstanding record in athletics and the contract says, "And such other assignments as may be deemed appropriate by the Superintendent." So I ended up coaching.

Senator DOMENICI. Jeff.

Senator BINGAMAN. Well, Ed, I would just say, my dad, who, as I mentioned before was head of the physical sciences department also, he used to tell me that football is to education as bull-fighting is to agriculture. [Laughter.]

So that is an example.

Let me just say that I once again want to thank Pete and the staff for involving me in this hearing. I think it was extremely well-organized and I think the witnesses certainly contributed a lot to my understanding of the problem and I appreciate it very much.

Senator DOMENICI. Thank you very much.

We are adjourned.

[Whereupon, at 5:25 o'clock p.m., the hearing was adjourned.]

SCIENCE AND MATH EDUCATION

FRIDAY, FEBRUARY 11, 1983

U.S. SENATE,
COMMITTEE ON THE BUDGET,
Las Cruces, N. Mex.

The meeting was convened, pursuant to notice, at 8:41 a.m., in the Korbett Center Ballroom of the New Mexico State University with Hon. Pete V. Domenici presiding.

Senator DOMENICI. Let us get started, please.

First, let me thank the university for providing the facilities for us and also thank Senator Jeff Bingaman, who attended the hearing in Albuquerque, where we had our first hearing on this bill.

I understand he is unable to be here with us today.

We are going to try to stay on time, which is, for those who work with Pete Domenici, a rare exception.

So let us begin.

OPENING STATEMENT OF SENATOR DOMENICI

NEW ERA OF ECONOMICS

The United States finds itself at this particular time on the brink of a new era in economics. Without any question, we are no longer in a world that is dominated economically by the United States.

Quite to the contrary, the future of our economic well being is tied to what other countries in the world do and our future is tied to excellence in science and math and engineering.

If we are going to maintain our standard of living and remain an economic power, and maintain our national security, the extreme deficiency in math and science proficiency among our high school students must be cured.

Ernie Boyer, a former U.S. Commissioner was quoted in the New York Times as saying that perhaps the United States would wake up when the Japanese put a Toyota in orbit.

The facts are dramatic: the lack of interest in math and science among our junior high and high school students; growing interest at the local level across the country in insisting on more math and science in schools; and last but not least, the rather substantial shortage of qualified math, science and physics teachers in the school systems of the United States, both public and private.

Almost every State is short of qualified teachers. Almost every State has teachers, men and women, teaching these subjects that are not properly certified. Our own State has a number of them on waivers of certification.

REMEDIAL COURSES TAKE HIGH AMOUNT OF RESOURCES

Last but not least, the valuable resources of our universities which are in short supply overall have been stretched further in the last 10 years by having to provide remedial math and science. At public 4-year colleges, 25 percent of the mathmatics courses are remedial, and at community colleges, 74 percent.

Now, in conclusion, one might wonder, why should the National Government be interested in this? And then, why should a committee that is looking at the overall economics of our country—fiscal policy, monetary policy and where we are going in terms of future growth be worried about this?

Why should we be worried about this?

Why should we spend money when our budgets are all being cut?

But it is obvious to this Senator that we do not have a responsibility to fix up only the 1984 budget. We do have a responsibility to see that this economy, which is improving, recovers for more than a couple of years.

We have a very basic responsibility to look and see what are the most glaring issues that will dictate whether or not we are going to be able to maintain the kind of growth and economic prosperity that a country with as fine an economic system as this one should have.

I have concluded that unless we produce more youngsters proficient in math and science and our colleges in turn focus a great deal more of their resources and attention to advanced areas of math, science and engineering, rather then remedial coursework, that the chances of long-term economic success are negligible.

With that, I will just make my formal statement a part of the record.

OPENING STATEMENT

BY

SENATOR PETE V. DOMENICI

SCIENCE AND MATHEMATICS EDUCATION

I want to welcome and thank our witnesses for coming here today. We all know that New Mexico is, for many reasons, unique. We have, within our borders, one of the highest concentrations of science and technology in the country. We have two nationally recognized laboratories, Los Alamos and Sandia, which conduct some of the finest research and development in the country. We also have very strong universities, such as the New Mexico Institute of Mining and Technology and New Mexico State University. New Mexico has, in recent years, become increasingly attractive to industry, particularly high technology industries. As our universities and the laboratories work more closely together, I have every reason to expect that this trend will continue.

This concentration of science, research, education and technology makes New Mexican's keenly aware of what we have now, and what we will need to do to ensure a prosperous future.

I am delighted to welcome our witnesses. Not only do they have the unique insight that comes from living in this state, each also represents a specific area of expertise which will prove invaluable as we discuss what I feel is a serious and growing national concern--the education of our children and the future of our country.

I am afraid that we have reached a point where we may be taking America's extraordinary technological achievements for granted. We

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think that our research and technology is now, has always been, and will always be -- first. Well, I will tell you, if we don't sit-up and take notice of what is going on in education, we can look forward to a dim future economically, technologically, and internationally.

Ernest Boyer, a former U.S. Commissioner of Education was quoted in the New York Times as saying: "Between 1958, when Sputnik occurred, and 1975, half a million secondary school teachers in math, science and languages had gone through summer workshops to raise their skills --- Maybe what we need is another Sputnik --- Maybe what we should do is get the Japanese to put a Toyota into orbit."

Let me list just a few of the disturbing facts which describe the nature of the problem:

(1) Every standardized test used to measure science and math capabilities has shown a steadily declining level of achievement over the last ten years.

(2) Between 1975 and 1980 remedial mathematics enrollments at four-year institutions of higher education increased 72 percent while total student enrollment increased by only 7 percent. At public four-year colleges, 25 percent of the mathematics courses are remedial, and at community colleges, 74 percent.

(3) Since the 1970's high school and college admission requirements for math and science have been significantly lowered from prior years.

(4) Only one-sixth of all high school students have taken junior or senior math courses. Two-thirds of the country's high schools require just one year of math to graduate.

(5) Only one-third of the 21,000 U.S. high schools teach calculus and fewer than one-third offer physics courses taught by qualified physics teachers.

(6) Today, 13 percent of all high school graduates are prepared for the engineering curriculum in college compared with 28 percent in 1972.

(7) In a study done by the National Governors Association, 43 of 45 states reported a shortage or a critical shortage of math teachers; 42 reported a shortage of physics teachers, and 38 reported a shortage of chemistry teachers.

(8) According to the National Science Board, in 1980 and 1981, experienced math and science teachers left their jobs at the rate of 4 percent. Another 25 percent expressed their intention to leave in the near future. A continuation of this trend will result in a net loss of 35 percent of the country's math and science teachers by 1992.

(9) Among newly employed science and math teachers, 50 percent were judged by their principals as being unqualified to teach their subject.

(10) Surveys indicate that among present math and science teachers, 79 percent have not completed a 10-hour workshop or course in their subject in over 10 years, 69 percent have never attended a computer course of any kind, and 40 percent have not attended a continuing education course since they began teaching.

I do not believe that our students have become duller or less capable of learning. The problem is that we need more teachers and better qualified teachers. We must do something to reverse this trend.

The Bureau of Labor Statistics projects that the demand for scientists and engineers to fill science and engineering occupations will increase by 40 percent between 1978 and 1990. Projections indicate that 180,000 new jobs will be available in the mathematical, physical and life sciences, 250,000 in engineering and -- the profession expected to experience the greatest demand -- 480,000 in the computer field.

Who is going to fill these jobs? How can we possibly expect to meet this demand if we do not do something to improve the math and science competency of our high school graduates? How are we going to do that without the teachers qualified to teach them?

Education of our workforce is the single-most important effort we can make to improve our nation's long term productivity trend and sustain our international competitiveness in key world markets.

Improvement in the quality of our labor force, through better basic education and training is the single most important contributor to our long-term productivity growth. Conversely, erosion in the quality of our labor force during the past decade has been the single largest contributor to the decline in our nation's productivity growth. Productivity is essential if we are to maintain price stability in this nation. It is essential to our international competitiveness. It is essential if we are to improve the standard of living in this nation. And, I must say, that American productivity is challenged by our competitors in the international marketplace.

Higher productivity and more rapid long-term economic growth are also essential to improving our overall budget situation and helping us put Americans back to work. We need to find ways to use our limited resources to improve the growth of the nation's economy.

We are now faced with budget deficits larger than any ever experienced in our nation's history. The President's budget forecasts 3.1 percent real growth in 1983 and 4.0 percent real growth in 1984 through 1988. If actual real growth is one percentage point lower than forecast each year, the budget deficit will be $83 billion higher by 1987. If the actual unemployment rate is 1 percentage point higher than forecast, it will add $37 billion to the deficit by 1987. It is clear that both strong economic growth and lower unemployment are necessary to improve the budget outlook.

No Senator has worried more about the effect that large deficits will have on our economic recovery. I have come to the conclusion, however, that we must plan for a long-term economic recovery, not a one to two year cycle of prosperity. We cannot afford to lose a generation of scientists and experts. We must make an investment in science and math capabilities to ensure that America can compete and that our future will be prosperous.

I hope that the math and science education bill which I have introduced will help to halt the declining achievement in these critical areas, will serve to encourage teachers who are already in the schools to stay, and will motivate young people to pursue teaching degrees in these subjects.

It is essential that we recognize this problem and deal with it expeditiously. To borrow an analogy from Carl Sagan of Cornell University... We are in a position of eating the seed corn. Here we are in the midst of a tough winter. We have stored some seeds of corn to plant next year. We know we can get through this winter if we eat the seedcorn, but then we will be in desperate straits the next winter since we will not have planted the crop for our future survival. I think we had better plant the crop.

I hope for us all, that Congress will act on this measure with some sense of urgency, so that we may begin to reverse the trends that threaten to hold us back in science and technology. We do have budget problems that we must solve, but we cannot forget the reason that we have become an international leader with one of the highest standards of living in the world. Our future depends on our children and the education they receive in our school systems.

Again, welcome to our witnesses. I look forward to hearing what each of you have to say on this important issue.

Senator DOMENICI. I will now put a few statements in the record.

I was pleased to read the column by James Kilpatrick which showed up in the Albuquerque Journal titled, "Domenici Bill Addresses Teacher Shortfall in Math and Science."

Considering the conservative nature of the columnist and his rather consistent philosophy of encouraging the local units of government and States to do more and the Federal Government to do less, it is particularly interesting. I am grateful that there is a recognition that we have a very big and difficult problem and the Federal Goverment has a role to play.

In addition, Dr. Max Bowlen, coordinator of science education at UTEP, has given me the result of a workshop on the math and science teacher shortage in the State of Texas. I am sure it contains some very valuable information. Dr. Pacheco of the University of Texas at El Paso has also sent his views.

There are a number of other people who are not going to testify here before us today that have contributed information so I would like to just acknowledge some written testimony that will be submitted for the record. A lot of individuals would like to testify, but unfortunately we just do not have time to hear them all.

Dr. Edington, of New Mexico State University, who is director of Education Research Information Clearinghouse on Rural Education, has submitted written testimony and it will be made a part of the record.[1]

[1] See p. 242.

Now, with that, I think we will proceed.

We will hear first from Dr. Byrne, dean of education at New Mexico State University. Before the Dean speaks, let me make an observation.

It is going to be very difficult to draft a bill that can pass in the U.S. Congress that balances two very significant national interests in this field.

The National Science Foundation, which basically has been involved in promoting research and development in science and the like in this country, has in the past been involved in scholarship programs and plays a very vital role in maintaining some kind of peer review with reference to science and math research and the selection of scholarship recipients.

Obviously, those who are part of the overall education system in the United States, from the colleges to the State boards, to the local boards and to organizations such as NEA also have an interest.

The problem we confront is that we probably cannot get a bill through the Congress that relegates the national effort in this regard exclusively to one or the other.

I understand Dr. Byrne has some very definite views on the relationship between NSF and education.

PRESIDENT PROPOSES INCREASE IN BUDGET

I am pleased to state parenthetically that in the President's budget proposals, while there is a general theme throughout the budget of not letting domestic appropriated programs grow, the budget does propose a significant increase for basic science and research.

The NSF and its related functions are in the President's budget for an 18-percent increase, for the 1984 budget. It is hard to judge what the administration proposes in 1985, 1986, and 1987 but at least Dr. J. Keyworth, the President's Science Adviser, has made some headway in terms of funding for basic research.

Now I look forward to your testimony and Dr. Byrne, if you would lead off, we would be delighted to hear from you.

STATEMENT OF DR. DAVID BYRNE, DEAN OF EDUCATION, NEW MEXICO STATE UNIVERSITY

Dr. BYRNE. I appreciate the opportunity to comment on the declining quantity of teachers and the quality of programs in math and science education in the public schools and to offer a brief commentary on the legislation introduced by you.

APPROACHING POINT OF SCIENTIFIC ILLITERACY

Your legislation makes obvious your awareness of claims advanced by the scientific community and the science consuming industries that our Nation is approaching a point of scientific illiteracy. Doubtless you have also reviewed the substantial data indicating the learning crisis in public school science and math education and the void of qualified teachers.

It would, I assume, be pointless to review those claims and the evidentiary data needed to support them. My review of the litera-

ture leads to the conclusion that these claims are, in the main, accurate and the situation is most critical.

Therefore, I applaud your attention and support the spirit of legislation which has been introduced.

In my brief comments regarding the general situation in math and science education, I will refer to recommendations made in two previous statements. First, I recommend you give thorough and serious consideration to testimony given by Dr. Anne Flowers, president-elect of the American Association of Colleges for Teacher Education to the House Subcommittee on Elementary, Secondary, and Vocational Education in September 1982.

Dr. Flowers makes several recommendations which parallel the proposals in your legislation. She does, however, offer some caveats of caution you might well consider.

First, you need to recognize that the shortage in math and science teachers has received great national attention but is not the only area of current or future shortfalls of qualified people in teaching.

Second, you must recognize that while first-rate competence in the areas of math and science is essential, it is equally essential that people placed in classrooms have first-rate competence in the professional practice of teaching.

Third, Dr. Flowers offers counsel in the context of the general principles which might guide deliberations.

I quote:

> State-by-state solutions should complement, not replace the Federal response to what is the national solution. It is time for a comprehensive look at all of the factors surrounding teacher recruitment, training, placement, and retention. Quick fixes to the crisis of the moment will not work.
>
> This is not an easy task nor will it be without cost. As long as we spend less to train a teacher than we spend to educate a third-grader, we cannot expect to have the kind of quality personnel in our classrooms that these children deserve.

SECOND RATE INDUSTRIAL POWER

The second statement to which I would direct your attention is the president's report made by Max Sobell, president of the National Council of Teachers of Mathematics in the spring of 1982 and published in the Mathematics Teacher in September of 1982.

Dr. Sobell refers to the negative impact our failings in math and science education will have on our economy by leaving us short of the brainpower to compete in our advancing technological world.

His comments and those he cites make it clear that without a reformation of math-science education, we look to a future as a second-rate industrial nation. A further point made by Sobell and one that I feel is important is that those prepared to teach mathematics must be prepared to teach. That is, to excite students' curiosity about and excite their interest in mathematics as a subject for learning.

He suggests that the conventional fashions for teaching mathematics are dull, deadly, and destructive of all interest.

Perhaps the most important point made by Sobell is his strong support of the position taken by the U.S. Commission on Mathematical Instruction.

That is, I quote, "That the greatest need and opportunity for improvement in mathematical instruction over the long term is at the elementary school level." I emphatically concur.

Since time does not allow for an extended or careful exposition on any or all points, I am going to make an abrupt shift and focus upon the legislation introduced by the Senator.

REASONS FOR SUPPORT OF LEGISLATION

As I understand it, an account of the arguments to support this legislation goes something like this:

(A) The future economic prosperity and national security of this Nation will be jeopardized if we fail to develop more competent scientists, mathematicians, and engineers.

(B) The current and future shortage of qualified teachers in math and science in our public schools will prohibit such development.

(C) We must invest resources in correcting the teacher shortage to help insure the development of skilled young people to protect our economy and insure our capacity of national defense.

Such a position seems sane and reasonable. More importantly, perhaps, it rests upon the most politically viable conditions, the economy and national defense.

It is a particularly powerful position when you compare our productivity of skilled people for technological work with other industrialized societies such as Japan.

EDUCATION USED AS SOCIAL TOOL

My response to that position is not a counter position. It is rather placement in context. That is, in the last 20 years, our national agenda for public schooling has been very different from that of Japan's. Persuaded by the social, egalitarian, and individual rights and ideologies of the 1960's and the 1970's, our congressional leaders, our courts, and our State governments set an agenda for public education to redress the history of social injustice and inequity, to counter or to correct social problems and to provide each individual with an education relevant to his or her own defined needs.

In most instances, the public schools now mirror that agenda. In a general sense, it is an agenda committed to the principle that the rights and individuality of each person take precedence over the needs of the society.

EDUCATION MUST HAVE AUTHORITY TO SET STANDARDS

Your position takes as its first principle that public schooling most first serve the eminent need of the society. It is not a matter of choosing which position is correct. A sound case can be made for either. Rather, it is a situation which argues that you cannot intrude the development of brain power in math and science without making the development of intellect across all areas of study the first order of priority of public schooling.

That will require the reinstitution of the idea that individuals have the right to an opportunity for education, not the right to an education.

To do that, we must reestablish the authority for schools to set high standards, supported by lawmakers in the courts.

The American public schools have always responded with great capacity to the national agenda. It is time for open recognition that schools do not make educational policy.

The public, through its elected officials, makes educational policy. Policy is not esoteric rhetoric expounding upon the nobility of learning, it is the statement of priorities found in the distribution of national resources.

Your legislation proposes a major shift in educational policy.

I wish to move, to just brief comments, on the three title programs in your legislation.

SCHOLARSHIPS AND TEACHING AWARDS ATTRACTIVE

Title I, congressional science and mathematical education merit scholarships and teaching awards, is attractive.

When one considers the number of people involved, it may, in actuality, be far more symbolic than substantive.

Secretary of Education, Terrel Bell, recently made the claim that, "If all high schools in the country raised their graduation requirements in mathematics by one unit, the demand for math teachers would increase by 34,000."

If Dr. Bell is accurate, you may wish to do much more in this program than prime the pump.

I wish to note one other matter regarding this program.

It is illustrative of a pervasive irony in all of the titles; that is, that though it is aimed at presumably improving teaching and teachers, you entrust it to the National Science Foundation and the Office of Science Technology.

Certainly they will insure that recipients have high intellectual ability, demonstrated aptitude in math and science, and evidence of superior academic performance.

That, to my mind, would be essential.

What puzzles me is that you seem unconcerned or unaware that these factors, taken alone, do not predict the capacity to teach well.

Who will assess candidates for the habits of mind necessary for teaching? Like much legislation aimed at improving teaching, it seems to scrupulously avoid the involvement in any serious way those who teach or study teaching.

COMMISSIONS ON EXCELLENCE RIGHT-MINDED

Title II, which proposes the establishment of Commissions on Excellence, seems to be a right-minded idea. In the list of responsibilities, you seem to account for most of the vested-interest constituencies that normally influence educational policymaking.

That may well satisfy and perhaps necessarily so, certain political realities. What it does not do is set out criteria whereby the meeting of these responsibilities might be evaluated.

A second point to be made is that the process for implementation and identification of Commission memberships seems at best to be conventional. History of similar programs would point to the use of most of the money to hire support staff for the Commission.

You might consider a somewhat larger membership directly funded to do the actual work in meeting responsibilities you have outlined. Resources funneled through standard governmental machinery usually end up funding more Government with little left to directly attack the problem at hand.

Again, one may note the omission of any member on the Commission who takes as a primary career interest the education of teachers and/or the study of teaching.

BLOCK GRANTS HAS PROMISE

Title III, like the others, has promise as an idea. I would point out that the moneys coming to States are targeted for the State agencies and local school districts. Although Item 5(B) allows for grants to institutions of higher education to improve teacher education programs, there is no direct funding for higher education. I wonder why this is.

Under limitation on use of funds, you just stipulate only 10 percent may be used for administration and only 40 percent may be used for equipment.

One way to look at that is to say that only 50 percent will be absolutely available for the investment in people who teach in programs to improve them. I would prefer a larger investment in teachers and prospective teachers.

The questions I raise today may be taken as essentially negative regarding your proposed legislation. That is not my purpose. Your proposal has my support. My criticisms relate to two points which I would like to make in conclusion.

CENTRAL ISSUE OF LEGISLATIONS

First, I do not believe the essential issue is one of economy for national security. It is that the purpose of Government in our democracy is to enhance, enrich, and insure a free and independent life for its citizens.

That cannot occur, in my judgment, without full resource commitment to the development of the mind through the public schools. The current situation regarding our need for skilled people to provide technological advancement does not make it essential. The conception we have always held of what sort of a nation we are has always made it essential.

FRUSTRATING TO BE BLAMED WITHOUT IMPACT ON COURSE

Second, and finally, I would point out that when those in government or those who influence government, find a discrepancy between their expectations from the schools and what the schools are doing, that the finger of guilt points directly at teachers in colleges of education.

In spite of the deluge of sensational reporting of teacher ineptitude and college-of-education inadequacy, the fact is that many public school teachers are excellent and many colleges of education are excellent.

In fact, their contributions far exceed, in many cases, what one might expect, based upon the resources invested in them.

It is, sir, damnably frustrating to have little or marginal influence on the construction of educational policy and to be held directly accountable for the shortcomings in those policies.

Not all who teach in public schools or in colleges of education happened to fall off a truckload of peaches while passing the scene. Many are bright, well-educated, thoughtful people. I suggest you talk to them in your attempts to improve teaching.

Thank you.

Senator DOMENICI. Thank you very much.

PURPOSE NOT TO RESTRUCTURE EDUCTATIONAL SYSTEM

Let me suggest that, I do not disagree at all with you, Doctor. When you consider that total U.S. expenditures for education is over $180 billion, a $230-million effort—such as my bill—has to have a purpose but it certainly does not have, as a purpose, the total restructuring of education and its goals.

The goals you described for education are certainly the primary ones in our country's commitment to education. The statement of purposes for this bill should not be construed to be changing those goals but rather taking a little piece of the problem and saying, "Could we direct attention at it?" So, I do not have a bit of disagreement with your analysis of the national problem and national goals for education in America.

CHANGE MIX IN COMMISSIONS OF EXCELLENCE

With reference to the State Commissions on Excellence we have been advised by a number of people that there ought to be a different mix of members. You have suggested that also. We totally concur and we will work on that with a number of people to see that it is done.

CHANGES IN COLLEGES OF EDUCATION NEEDED

There is no doubt in my mind that many changes have to be made in our educational system. In terms of math and science, however, I would suggest that colleges of education have to make some major changes, too.

Let me tell you what I was told in Albuquerque. If you were to ask the math department at UNM—because I received their testimony, I will use UNM as an example—if you were to ask what resources of that huge math department are allocated to work with the College of Education to produce math teachers, the answer would be, 1 professor out of 40.

Second, if you were to ask math or science professors in the university, even those who were charged with working with the College of Education to educate teachers; if you asked them were they teachers or scientists, they would not answer "teachers."

They would answer, "I am a mathematician." "I am a scientist." "I am a chemist."

I think, listening to your testimony, you are acknowledging that.

In fact, we had a very exciting witness in Albuquerque. Maybe you have met him, Dr. Muller, from Highlands University. His degree is in science education, Ph. D. He made some profound prop-

ositions regarding science education, in a sense accusatory, of those that are scientists and mathematicians because they do not consider themselves to be teachers.

When he finished, he was somewhat surprised at my first question to him which was, "What do you consider yourself?"

And I guess he is an honest man because he should have said, "I am an educator." But he did not. He said, "I am a scientist."

Now, I think that basically there is a great sharing of responsibility for education, especially in the math and science area. Our scientists have to begin to consider themselves as educators, not merely researchers or inventors.

I would submit that this is a very big problem for all of us. Those who run higher education have a major role there, also.

PIECE OF PIE BETTER THAN NONE

I think your testimony is very constructive and I appreciate it very much. My staff will be working with many people in the country. Many bills will be flowing through the Congress and we will do our best to get in touch with you to see that we enact the best possible bill.

The one thing that excites me at this point is that there is a growing consensus that we ought to enact some legislation. We are not going to enact many new programs this year, but we will set our goals and then proceed to do the best that we can do.

And I am going to try to do that. I do not want to end up with no bill because the problem is so large and so dynamic and so comprehensive that we end up saying, "Let's wait around and do something later or wait until we can do something much, much more."

I am very hopeful we will enact something in this area and maybe it will improve things.

Let us take our next witness, Dr. Clay Smith from the New Mexico Institute of Mining and Technology. Dr. Smith, it is good to have you here.

STATEMENT OF DR. CLAY SMITH, NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

Dr. SMITH. Thank you, Senator. I might say that I find myself in considerable agreement with what Dr. Byrne has said. There are certain areas I would treat a little differently. And I have just a few points that I would like to comment on and a few questions regarding the outline of the bill as it has been presented.

DIFFICULT TO LEGISLATE EXCELLENCE

First, let me say that I think we have to face the fact that it is very difficult to legislate excellence and it is also very difficult to purchase excellence since excellence often seeks its own reward in areas that are not necessarily related to financial gain.

I think it is very possible to simulate a striving for excellence, although it must be realized that the striving may never succeed in reaching the goals desired.

One of the problems which we have in this connection is that our educational system, and here I am speaking, perhaps, of society as

a whole rather than simply the colleges of education or the schools in particular.

The educational system should simply face reality to the sense that failure is a fact of life and no stigma need be attached to failure as long as a determined, sincere, and whole-hearted effort toward success in a given endeavor has been made.

The real failure is the student who has not worked up to his or her potential, regardless of the level of ability.

The technology explosion impacts every phase of our society and requires a greater effort on the part of all citizens. A major part of that effort must be in developing a better understanding of the scientific and mathematical foundations on which the technology is based.

RETRAINING OF PRIMARY SCHOOL TEACHERS

Our educational requirements must be modified to force students to develop a minimal comprehension of science and mathematics which is considerably greater than the present standards. Such a program should probably be directed at the retraining and upgrading of the primary school teachers since these formative years are the most critical.

In terms of the bill itself, title II, is probably the weakest part of the bill simply because it is going to investigate a problem we already know we have. The money might better be added to title III and let the local entities deal with their specific problems.

And a comment here which I think that probably one of the major problems which is related to our secondary or primary school problem is that primary teachers in general have education degrees.

CONFINE SPECIALIZATIONS TO GRADUATE DEGREES

I think that there should be only content degrees at the undergraduate level. And specialization, including specialization in education, should be confined to graduate degrees.

This is not to say that education courses should not be taught. It is just that it should not be an undergraduate major. It should be a service department to all areas in the same way, for example, humanities is a service department to engineering majors.

And one of the points that was raised by a colleague of mine at New Mexico Tech was that he taught primary teachers chemistry to at the university level but they had taken absolutely no university math classes and to try to teach chemistry to somebody who has had no university mathematics at all and perhaps minimal or meager secondary school mathematics is very difficult.

FEATURES OF THE BILL

In terms of the bill itself, I have some questions which I will simply pose. First, title I, item 3, are the scholarships to be for lower division or upper division students?

Are they renewable for a second 2-year term? And should the scholarships perhaps revert to interest-bearing loans if the teaching requirement is not fulfilled?

Title I, item 4, perhaps some award criteria need to be spelled out here; larger and better-equipped schools should not be given an undue advantage to their teachers as compared to a small, rural environment.

This is in connection with the teacher awards.

The criteria should avoid ratings which are based on student test performances since these are not entirely reliable except over a very long period of time. In this case, perhaps the National Science Foundation peer review approach would be the best.

In title II, as I indicated, this is the weakest part of the bill as far as I am concerned, but if it is to be implemented, in 3(A) I suggest that the scientist indicated be a college-level person and the science teacher be a secondary-level person.

The same thing with the mathematician. A college-level mathematician and a secondary-level math teacher.

The (C) item, an elected member of the local school board. And for the sort of general member of that indicated pattern, the item (E), a primary teacher at the fourth or fifth grade level.

In title III, I would like to see a large fraction of these funds, 25 to 50 percent, for example, be restricted to students who are receiving content degrees rather than education degrees. This bears on the item I mentioned regarding the fact I think all undergraduate degrees should be content degrees.

Item 3(B), the local education agencies would have to set up proposal evaluation panels or some similar mechanism and here perhaps the Department of Education or NSF could provide that kind of service.

Item 3.5(C), this support should be severely restricted in terms of stipends. This is for helping teachers. Travel payments and supplies and equipment should consume essentially all of this allocation.

Item 3.5(D)——

Senator DOMENICI. Why that one? I understand all the rest but——

Dr. SMITH. One of the problems which we have had with some of the NSF programs is that they have been treated in some cases, particulary the summer institutes, as a vacation by some of the participants. My feeling is that the support for summer institutes should be basically travel and equipment or books, not stipends because this tends to create the idea of a paid vacation.

In item (D), in areas of low population density, the idea of centers of excellence just does not work. There is too much travel involved. In a high-population center, yes. A center of excellence is a very reasonable way to go at this but you should not, restrict it to that area. Here in New Mexico, we have got basically one area of population density which is Bernalillo County and I have been involved in some in-service institutes for teachers. In order to get together with those teachers, I traveled over 50,000 miles one year.

The teachers themselves, in order to get together with each other and me, traveled over 40,000 miles. So that unless we can have a traveling center, it just does not work very well.

Item 3.5(E), in-service training is probably the most efficient method of using funds and in 36(A), my inclination is to simply say, "Let's cut the administrative costs some more; perhaps a maximum

of 5 percent rather than 10 percent" and on (B), I would suggest that a larger percentage might be utilized in any given year for funds for equipment if the justification is made and then reduce the funds in future years so that the total over the period would not exceed the 40 percent.

Thank you.

Senator DOMENICI. Thank you very much.

INTERNATIONAL SCIENCE FAIR

Dr. Smith, I am aware that you have been a leader in organizing the science fair. You know, when you get right down to the bottom line, all the National Government is really going to be able to do is to join with many people in the country to create a new environment and disposition toward math and science. The science fair is obviously something that has been extremely successful in running contrary to the current and I compliment you for it and I understand we are going to have the International Science Fair in New Mexico.

Dr. SMITH. Yes; it will be in Albuquerque from May 9 though May 13 and we have already invited all of the high schools in the State that care to come to bring students on the Thursday and Friday, the 12th and 13th.

We have had response, incidentally, from 38 high schools already that are interested in coming.

Senator DOMENICI. That is wonderful. The other thing that I noted in the testimony in Albuquerque was that there would be an effort made to use the science fair, as further stimulation to the young people. The big laboratories will be part of the event and the students will get to visit some of the exciting things that are going on at Sandia and Los Alamos.

I hope, from everything I understand, they are cooperating with you. We want to continue to pursue it with everyone's constructive ideas, so we can maximize the use of those huge installations with their fantastic science capabilities and their great minds.

Are they working with you?

EDUCATIONAL ADVANTAGES OF FAIR

Dr. SMITH. Yes, indeed. There are basically three major educational advantages to a science and engineering fair. One is the contact that the students have with other students from other parts of the country and the world, to find out what is going on.

We will have 10 foreign countries represented, 47 to 48 States as well as the District of Columbia and Puerto Rico. The contact between the students in their fields of interest is an educational advantage which I do not think can be duplicated anywhere.

A second advantage is tours which are taken to these various facilities. We will be traveling to Los Alamos National Laboratories. We will be going to Sandia, Kirtland Air Force Base, Loveless Medical Foundation, and the University of New Mexico Medical School. We will be going to Socorro and the National Radio Astronomy Observatory, and the VLA. Finally, there is an educational advantage which comes from each student's project. Many teachers, and many educators think that individualized instruction is one of

the best ways to teach and the science fair project is, indeed, individualized instruction.

It takes a little time from the teacher and this is why sometimes not all schools will participate but it is a major advantage.

Senator DOMENICI. Let me ask one question of both of you, although I will be very interested in what the teachers who are going to appear say in response to this question.

REASON CHILDREN HATE MATH

The testimony that I have received to this point would indicate that by the time students in the United States get to the fifth grade, many of them already hate math. I think you were referring to that, Dr. Byrne. You did not say precisely that, but you said we had better focus some attention there.

In just a very short answer, if that is true, why is that?

Dr. BYRNE. Well, I think Dr. Sobell, whom I cited, suggests that one of the reasons is the way we teach it. I think, and quite clearly I am in agreement with Dr. Smith, that elementary teachers tend not to be prepared in math. That is another thing that happens.

I came here from Utah 4 years ago and we had conducted a study of elementary teachers in Utah and we found at that time that less than 34 percent of the elementary teachers in Utah were competent in math at the sixth grade level. So part of the answer has to do with formal training and I think part of it has to do with their experience in the public schools with mathematics.

Generally, math instruction is not well-done but secondly, when students get behind because they are bored, later when it gets difficult, they become afraid of math further, in New Mexico, we only have a 1-year requirement in math and many, many of the young people we get who wish to be teachers and wish to be engineers and wish to pursue academic degrees at this university, very simply come to college with less than ninth grade level in mathematics.

So I think that they are afraid of it by the time they get to the university because they failed at it previously and then they face the requirement they have to do some math. And part of that has to do—and I do not disagree with Dr. Smith on the need for content, but part of it has to do with the fact that part of teaching is more than knowledge of math and science facts.

Part of teaching is being able to excite people about the content you are teaching and I do not think that occurs.

STYLE OF TEACHING MUST BE CHANGED

Dr. SMITH. I would agree whole-heartedly with Dr. Byrne.

One point that I would like to make is that mathematics is basically a language and a shorthand for logic. Unfortunately, it is not taught that way. It is taught as a kind of secret that the teacher knows and the student must learn; must penetrate some kind of veil of impenetrability. If math were taught more as a shorthand language, I think there would be far less fear.

Senator DOMENICI. Let us go on with Ms. Janet Seagrave, director of economic development from Roswell. Thank you for coming, Janet. I know how diligently you work in trying to encourage eco-

nomic development in your area. I certainly did not invite you expecting you to be an expert in education but I think by the time we are through, we will have a lot of different interests represented and I thought we ought to hear your version of this general area. So we look forward to hearing from you.

STATEMENT OF JANET SEAGRAVE, DIRECTOR OF ECONOMIC DEVELOPMENT, ROSWELL CHAMBER OF COMMERCE

Ms. SEAGRAVE. Thank you, Senator Domenici. I appreciate that.

I thought the best approach for me to take today was to discuss the labor situation, the preparation of our labor today for the industries.

I would like to go back to 1972 and a conference in the White House on the industrial world ahead. We met to discuss the changes of our industries and to analycize the working world of Americans in the 1990's.

There are five key points that were brought out in a speech that was given by then-Secretary of Labor, J. D. Hodson. I would like to go through these because I think it very much affects the situation that we are in today.

The five key points were the right to work with emphasis on provision of job opportunities in the country; the obligation to work, especially as work relief is challenged; the equal opportunity for work in which principles we have adopted are fully implemented; work on human fulfillment and most importantly, what was brought out that day was the education and training for work in which concern is focused on more effective training, not only for youth but throughout careers.

LABOR KEY TO INDUSTRIAL LOCATION

These aspects of labor situations have important implications for those involved in the industrial location decisions. After all, labor, as part of the human resources and the production process, is the key factor in the location of economic activity.

The typical industry location decision focuses upon several aspects of labor; its availability geographically and by job type, the labor costs, including wages and other benefits, and the strength and activities of unions in the area. The major area of concern today, though, is the quality of the labor, which takes into consideration its general health, education, and welfare as well as the productivity and the degree of experience and skills that it possesses.

There has been a significant change in the labor analysis and the practice of industrial development as the decade of the 1970's brought forth a growing decline in the number of regular manufacturing workers and moved toward increased employment in the services and informational community industries.

MORE EDUCATION REQUIRED FOR NEW JOBS

This shift among the major employers demanded higher skill and higher educational levels from its workers.

During the past several years the location of engineers and the educational institutions that support expanding employment of en-

gineers as well as continual graduate engineering opportunities have been major decision factors regarding expansion and/or relocation of developing high-tech electronic corporations.

The rapidly changing, specialized and technologicallyoriented society requires better-educated and competent people. There is a great need for professional, technical, and vocational programs which can provide educational experiences to prepare students for these complex career demands.

In addition, job-related continuing education and lifelong learning are required as more and more people must adjust to changes in their work and their lives as a whole.

Advances in society occur as a result of research and the sharing of research results.

INDUSTRIAL MILLIONS SPENT ON REMEDIAL EDUCATION

Secondary as well as post-secondary education must provide leadership in meeting the challenges of our society. It is astonishing when you are looking at the present situation which some of our industries are facing, 75 percent of the corporations responding recently to the Center of Public Resources reported they are having to spend annually millions of dollars on remedial training programs for their employees, who have graduated from school and find that they cannot understand information, cannot read or compute it, let alone be able to deal with the mathematics that are required.

In our State I know there are several large industries, primarily in the Albuquerque area that do participate in remedial kinds of programs and it is a hardship on them.

Regarding industrial development and expansion of industries to communities, today communities such as Roswell, N. Mex., that I represent, are primarily limited in the type of industries that we can attract and keep due to the limitations of our education facilities.

With approximately 50 engineering schools in the country, the high-tech industrial sector is primarily going to be situated around those institutions, as we saw in the birth of Silicon Valley in California. The development there; that economic base came about through the combination of higher education and expertise and the capital to support development of industry.

I commend your bill. I think it is the first piece of legislation that we have seen in the last several years that will encourage and help develop programs in our States to come to the aid of industry that are trying to grow and expand by providing the labor force that they need.

LACK OF FUNDS LIMIT TRAINING

In a FANTA study that was recently done on the State of New Mexico, one of the major problems in our educational limitations is the fact that we are limited in our vocational programs and our universities are also limited primarily due to funding. New money sources such as your scholarship programs as well as direct funds to the State will help establish new programs.

Thank you.

Senator DOMENICI. Thank you. How long have you been working in this area?

Ms. SEAGRAVE. I have been in it for 10 years.

Senator DOMENICI. And how long in New Mexico?

Ms. SEAGRAVE. I have been in New Mexico for approximately 16 months.

Senator DOMENICI. Prior to that, what States have you worked in?

Ms. SEAGRAVE. In Texas and the State of Missouri.

HIGH TECH INDUSTRIES LOCATE NEAR BIG SCHOOLS

Senator DOMENICI. Do you find similar problems exist everywhere?

Ms. SEAGRAVE. Yes, I do. It depends on the individual communities, how close they are to higher schools of education. It seemed that in the field of industrial development the concern shifted from the numbers of employees or the numbers in your work force to, all of a sudden, how many engineers do you have in your community? Or where are the engineers?

For example, Rockwell International was an industry that I worked on a location analysis for Amarillo, Tex. Rockwell does not hire Ph. D.-level engineers. They will hire only in the master's level or below but they want all their engineers to eventually have Ph. D. degrees.

So in other words, they will not locate in a community that does not have graduate programs for their employees to fulfill their educational requirements.

It definitely can be a hindrance and a handicap for a community that is isolated from a 4-year university or does not have a 2-year program that can produce technical expertise.

Joe Buch, senior staff engineer, Space Communication Co., Las Cruces. We welcome you, Joe.

STATEMENT OF JOE BUCH, SPACE COMMUNICATIONS CO., LAS CRUCES

Mr. BUCH. Good morning, Senator.

Space Communications Co. is, I guess, the only industrial representative on the panel this morning. I would like to explain a little bit about what we do and how we relate to this problem.

We are the prime contractor for the National Aeronautics and Space Administration of the tracking and data relay satellite program. This is a $2 billion program which will eventually result in the ability to provide worldwide communications for NASA's low-orbiting satellites and the space shuttle.

CONSUMER OF TECHNICAL TALENT

We are located about 15 miles east of Las Cruces at the NASA-Johnson Space Center Facility. We fall generally into the category of service and information industry that Janet spoke about a few minutes ago and as such, we are a consumer of technical talent.

We are the people that benefit directly or indirectly from the quality of education that is provided by the institutions that are represented here today.

We employ approximately 240 people. Three-fourths of them are technical engineering people or vocational level technical people and we are in a very high-technology business, the business of satellite data communications and data relay.

I am not totally isolated from the teaching world, however, since I am married to a teacher who teaches here in the Las Cruces Public School System and one of the courses she teaches is science at the junior high level.

I know, therefore, that teaching is a very demanding job and one which the monetary remuneration is, as someone else alluded to here earlier, not the entire motivation for doing it. I believe that a good teacher is one who is dedicated to the students. I am not sure they make minimum wage. Let us put it that way, when they add up all the hours of preparation and outside activities that they have to participate in or that they want to participate in.

I am a last-minute replacement for Bob Gamboa, who sends his regrets at not being able to come here today and I was only briefed on this bill this morning so I have not really had a chance to study it in detail.

ROLL FOR INDUSTRY IN ENHANCING TECHNICAL EDUCATION

However I do feel there is a role for industry in the area of enhancing the technical education of our young people. I think that role is in the area of motivation, the area of exposure to the real world of engineering and science. Our company, for one, has held open houses out here at our facility for the families of employees, for folks in the community in general, to give them an idea of what it is we are doing and the kinds of skills that we need.

We, for instance, employ many people in computer science, approximately 40 people in the area of software development and that sort of thing. We have about 30 graduate engineers, about 56, I believe, technical people of satellite control and operations.

All of these functions are ones which can give people a view of what the real world is out there, what the real jobs in engineering are and I think that your title III, section 5(C) is good as far as it goes. I do notice that in supporting or that in encouraging industry cooperation with the educational community, the bill encourages voluntary efforts of individuals to contribute to public schools through seminars, demonstrations and team teaching.

The Government, in its capacity as a major distributor of wealth in this country, has included in the Government contracting process many things which are socially oriented. That is, requiring that a certain amount of our business as a prime contractor flows down to small businesses and things of that nature; the equal employment opportunity requirements and so on that are injected into our contracts with the Government also have a social benefit. This may be an area where Government contractors could be given some incentive to assist the educational community, maybe by allowing the certain small percentage of the hours on a costplus contract of some sort to be devoted to this sort of activity; make it an allowable cost on those contracts to devote some effort to this problem.

And that is about the only positive suggestion I have at this point. I think that I do not have anything to disagree with from what I have heard from any of the other members.

Senator DOMENICI. With reference to sharing with educators, do you see the present situation as too restrictive in terms of helping in education at this point?

Mr. BUCH. I do not think it is necessarily restrictive but I think that it is more omission than any firm barriers.

Senator DOMENICI. I note that some companies find a way to help and I assume that you are suggesting that that may be made more clear and more positive.

Mr. BUCH. There may be a way in the Government's contracting world to encourage this sort of participation, be it in the form of award fees to contractors who do this kind of thing voluntarily or be it in direct subsidization of the cost of doing this kind of thing.

Senator DOMENICI. Well, we will make at least a few broad inquiries as to how much is going on and what those who are the beneficiaries of it think in terms of whether such a change would be helpful or not.

Let me ask Dr. Smith one additional question.

INDUSTRY PROGRAMS TO PROMOTE MATH AND SCIENCE

At the hearing in Bernalillo County, somebody raised this issue. Several years ago, GE and a couple other of our major American companies had rather exciting programs designed to promote science and math among the young people. Apparently these are not going on any more. Do you know what I am talking about? I really was always enthused about math and science myself. I ended up being certified to be a math and science teacher and actually did that for a little while. But why have those programs stopped?

Dr. SMITH. Well, I think it has partially stopped because of activities of the National Science Foundation in terms of student research participation programs, secondary school programs. In other words, the companies said, "Well, if the Government is going to do it, why should we."

I should point out that General Motors is supporting the International Science and Engineering Fair to the extent of $100,000 a year. In the last couple of years when the profits have not been quite so good in the automotive industry, one of their vice presidents was asked whether or not they were going to reduce or stop their contribution and he said:

> That is the farthest thing from my mind because we think this is the only way to aid and support science education, science and engineering education as far as the country is concerned.

COOPERATIVE BETWEEN TEACHER AND COMPANIES

I might also add in connection to those comments that that is one way in which there might very well be a major effort made: To provide what might be called a cooperative program between teachers, secondary school teachers, and companies where the companies would provide employment in the technical fields during the summer on a part-time basis or on a cooperative arrangement. This would supplement the income that the secondary teacher or even

primary teacher gets and would probably serve both areas quite well.

Senator DOMENICI. Now, if that is going on at all, it would be within the normal contract arrangement and they would have to figure it as a normal, allowable cost. The suggestion you are making is that we might explore that as one of the goals and objectives in letting contracts or in our co-owned Government corporations that do that kind of work.

Dr. SMITH. Yes. I think that right now it is basically simply the fact that some teachers do it on their own.

In fact, some teachers insist that if they could not do it, they could not teach. They could not afford to.

Senator DOMENICI. All right, I am most appreciative of your joining us here today. Thank you very much.

[The first panel of witnesses was excused.]

Senator DOMENICI. Let me ask if the fourth group of panelists is here—Vodene Patterson, a math teacher from Carlsbad who happens to have another exciting job as president of the New Mexico Education Association; Luann Sisson, Las Cruces Middle School; and Mr. Herb Hammond, Alamagordo, chairman of the high school math and science department; and Fred Vega, principal of Silver City High.

Welcome all four of you. I would like to share two experiences with you.

When I taught school—I do want you to know that even back then the reason I got a job in the Albuquerque public school system, Vodene, was because I was a good baseball player and the principal said, "If you will coach baseball free, I will give you a job."

I probably did as well in the gratis job as I did in the paid job.

STUDENTS NOT READY FOR ALGEBRA

My fourth period class was introduction to algebra. My class was split in two. About half did not know how to add and half were ready to learn algebra. I can assure you that I loved what I was doing and that class was a rather fantastic challenge. I was supposed to ignore half and teach the other half. That did not seem too fair but I did not have any equipment to teach the half that did not know how to add. But it was a lot of fun.

We made our own book. We mimeographed copies. They would not let us put up a little partition so I could teach two classes but nonetheless, the ones that were ready for algebra had to take care of themselves part of the time and two or three of them had to help me teach the other group. We ended up at least so that everybody knew how to add and subtract and knew how to write out a check in case they ever had a checking account.

I did not leave the profession based on that experience. Somebody just challenged me to go off to law school.

I only tell you this story because there is so much talk around that people in this country have changed and do not want to do things like that. Certainly there is a lot of perceptions around about our school teachers and I thought I might just share this

story with you, just to let you know that I have the greatest admiration and respect for teachers.

The subject matter is eminently important but really the bottom line is that we do not need scientists in our high school science classes, we need teachers that like to teach science and we do not need mathematicians, we need teachers who like to teach math.

GOALS OF THE BILL

I hope you will all understand that there are two goals regarding this bill. One is to try to get something like it enacted. The other is to lend my voice, for whatever value it has, both in my State and in this country, to stimulating and encouraging a much broader base of citizen interest in this very significant area of math, science, physics, and chemistry and the difficulty our public school systems are having in generating the kind of excellence that obviously we have to have.

NO EDUCATION DICTATOR NEEDED

I do not think it serves much purpose to compare our system with Russia's, although the objective comparison in terms of math and science is absolutely startling. I do not think it even does a lot of good to compare it with the Japanese because ours is a diverse educational system. There is no dictator of education and I think I know from all of you that you would not want national control that eliminated local participation and State boards from the educational system. Maybe we have a more difficult job but I would think in the end, when we improve our schools we will be the best in the world.

I think it will prove what we have always proven in America, that diversity and local input improve our country.

Having said that, I want to thank all of you for coming and I look forward to hearing from you. Vodene, maybe you could lead off.

STATEMENT OF VODENE PATTERSON, MATH TEACHER, CARLSBAD; AND PRESIDENT, NEW MEXICO EDUCATION ASSOCIATION

Mrs. PATTERSON. Thank you, Senator. And I appreciate your comment that you are willing to look at something even better because that is what I would like to encourage you to do, I appreciate the invitation to appear here to share my thoughts and concerns about the declining participation and interest in math and science and I will have to tell you that I will digress at times from my role as a math teacher and express my concerns as a mother and a grandmother also.

So I will beg your indulgence to do so.

Senator DOMENICI. Of course.

Mrs. PATTERSON. My concerns pertain to developing to the highest possible level, those abilities the child has in math and science without ignoring the reality that communication skills and proper guidance, must not be neglected or the potential will never be utilized.

I sincerely believe that the greatest resource that our country has is its children and I believe that every child shall have an op-

portunity to achieve, regardless of its background, race, religion, financial status or the place of residence within the country.

We must, as a country, decide if, in fact, education is our priority for if it is, we must make sure that we spend the necessary time, the talent, and allocate the needed financial resources to motivate the minds of our children.

If we do not consciously and continuously provide the needed resources of time, talent and money on education, then the resources extended by any legislative governing body or industry on machines and technology invested in research or defense or devoted to new products will be underutilized and much money will be wasted.

This country will also lose its status as a technological and scientific leader.

To address the issue of time and talent leads us to the key person in that issue, of which I am concerned, and that is the teacher.

FACTOR OF BILL ADDRESSES TEACHERS

Your proposed legislation has two factors which address the teacher.

One, recognition of practicing teachers with an award and two, encouragement of future teachers with funding assistance.

The proposed legislation does not recognize the more serious side of the problem, earnings and opportunity. I need to share with you my personal experiences because I think this experience will speak to the reasons why there is a shortage of math and science teachers and even more, why the forecast is for increasing shortages of talented teachers in all areas.

In 1955 when I entered college with some talent in the field of mathematics, attempts were made to counsel me away from the math, physics, and engineering fields. These fields were closed because of my sex and it continues today. I prevailed and earned a bachelor's of science degree in mathematics.

I also chose to prepare for a teaching certificate.

Several years later, I entered teaching and discovered I thoroughly enjoyed working with the kids. I believe that I am a good teacher and have taught math in grades 7 through 12 for 20 years.

INCOME CRITICAL TO TEACHING PROFESSION

Frankly, though, if my husband had not had a career that provided sufficient income for our family, I would have had to leave teaching many years ago. I have seen many of my colleagues leave teaching, some with tears, some with bitterness, all with sadness; sadness because of being placed in a situation where they had to choose between what they felt was of supreme importance to society and their obligations to their families.

Financially they could not afford to continue teaching. I have seen industry representatives offer my colleagues salary increases of $5,000 to $10,000 more than they were making as a teacher, recruiting them directly from the campuses of the schools.

I know of young men who left the teaching ranks in Carlsbad and went to work in the potash mines for more money and less hassle.

To continue, my three children, all of whom would have made excellent teachers and are reasonably talented in the areas of math and science, chose other careers.

My oldest daughter, Faye, stated when we questioned her career choice:

> Mom, I can calculate my lifetime earnings and they would be a heck of a lot more than if I become a teacher. The company will pay for my fringe benefits. I have investment opportunities. The company will pay for my advanced degrees. And besides, I have watched you work hours at night without pay, pay your own way back to school, handle irate parents who place all the responsibility on you and accept none themselves.

And there was no way she would consider teaching as a career. She began working 2 years ago for $6,000 more than I was making at the time with 19 years of experience as a math teacher.

To add to the story, my son just graduated from this university, and has accepted an offer from the Navy, which is more money than I am making now and half of it is tax-free.

My third child is a current student in this university and also dismissed teaching relatively early as the career choice in favor of a degree in engineering because of the monetary rewards.

I tell you this because I want to emphasize that to attract the best minds and the most creative, talented teachers an absolute necessity is to make sure there is adequate compensation.

NOT WILLING TO PAY JUST MATH AND SCIENCE TEACHERS MORE

I am not willing, as many are, to pay math and science teachers more and others less. Because as a junior high and senior high math teacher, I know that the foundation for my subject and the fundamental concepts, are developed from the primary grades on up.

If we want students to do well in math and science, the enticement must begin very early.

Senator Domenici, I have reviewed the legislation that has been proposed, including Representative Perkins bill which places $300 million into the first title, that is direct aid to elementary and secondary schools as well as containing two other titles, one for higher ed, in direct work with local educational units, and the third being for research and technology and also, the American Defense Education Act which has also been introduced and placed more than a billion dollars into direct aid in schools. I consider these serious attempts to address the underlying needs that have been identified.

While I appreciate the thought and concerns behind the legislation that is presented here, I do not feel that it is sufficient to address the needs.

I fully realize the financial situation we find ourselves in nationally and believe that education must become a first priority to alleviate the situation. The necessary financial resources must be allocated to this area. The expectations placed on our children must be reasonable and yet provide for the needed training and development of the thinking ability of each child.

I encourage you to support the needed funding because time is against us. The child who entered first grade this year is being trained at this moment, now in the schools, to be the doctor, the

lawyer, the engineer, the Congressman, Senator, soldier or whoever until the year 2041 when he or she will be 65.

His or her training and ability to think will affect our society from the year 1994 until he or she retires and I want the most productive and most sound economy and the most creative society we can plan for and produce.

In the schools at this moment we are preparing the children who will confront the future crises, conflicts, diplomatic wars, and who will man the defense facilities. If the schools do not have the needed manpower, tools, programs and technology the future is shortchanged. We will repeat this dialog in the year 2000, as we are now repeating the dialog of the late 1950's.

We have an opportunity to break the cycle and I am asking you not to be limited to the concerns of today and to take the strong leadership role that is needed to plan for the future.

I think we will have succeeded and I look forward to the day when each individual in this room can and will truly encourage their own children to be teachers.

I thank you.

BILL CAN GET HOUSE SUPPORT

Senator DOMENICI. Let me thank you very much. I would say that Chairman Perkins' bill has a much, much broader thrust. I do understand, by way of hearsay, that with reference to science and math excellence, that he has seen this proposal and has been heard to comment that if the U. S. Senate would pass something like this, in this particular area, that it would not take long to go to conference and we would have a bill enacted this year.

I think that is a realistic assessment by Chairman Perkins.

I do not believe we are going to get any bills passed that add the amounts of money that have been described in the two other proposals, while they are excellent. I do not think that this is the year when we are going to really appropriate anything in the nature of a couple of billion dollars.

So I am very hopeful that somehow between all of the proposals we will get something that adds a new title to the existing education legislation and directs attention to science and math education which we all know is so critical.

STUDENT LOAN FORGIVENESS

Let me ask, in terms of the attractiveness of pursuing a college degree in teaching math or science, do you think that there might be a bit more emphasis or willingness on the part of young people to do that if there was some kind of major forgiveness of either State or Federal loan programs that help them get through the 4 years?

Mrs. PATTERSON. I suspect so but then I suspect that they will teach for 3 years or whatever the limit of time is and then leave, as current math and science teachers are leaving. So that we will be training again, not the teachers that we need, but the people that industry and the Government are needing in other areas. I see it as a short-range solution, to the severe long-range problem.

Senator DOMENICI. Someone suggested that a 3-year commitment for the scholarship program ought to be included and I said I tended to agree but that I did not feel like putting people in bondage. But maybe it could be tied in some other way. In spite of your belief that commpetitive teachers' salaries should be the goal and ideal of the country. I fear we are not going to do that soon. When you look at the amount of money that school districts spend on teachers salaries, I do not think we can expect them to compete salarywise with a private sector engineer with 10 years of experience. Obviously, though, teacher salaries must increase. Your job is to remind everybody of that and I think that is what you are doing here today. The salary issue is very, very important and there is no question about it.

Ms. Sisson, would you care to testify?

STATEMENT OF LUANN SISSON, SCIENCE EDUCATION ADVISORY TEACHER, LAS CRUCES MIDDLE SCHOOL

ALL TEACHERS WON'T LEAVE AFTER FORGIVENESS REQUIREMENTS

Ms. SISSON. Yes. I would like to add one comment to what was just said. I believe that once teachers are in the field of science and math teaching for 3 years, that many of the better teachers get hooked and really enjoy that teaching and will stay in teaching. I do not think that all of them will be wooed away by industry.

PROVISIONS OF BILL LOOKED AT

Senator, there are two areas in Senate bill No. 248 that I feel are particularly important.

Since the National Science Foundation already exists, I am pleased to see that some funds will be channeled throuqh this agency. It was the Foundation's original charge to facilitate science, research and education. It seems that recently we have neglected the education aspects of the Foundation.

Since the machinery is already in place for the management and allocation of funds, I think it is wise to use the Foundation rather than create a new agency for this purpose.

The block grant format is also particularly suitable because it provides necessary flexibility.

In addition, I am particularly pleased to see that elementary science is being supported in this bill. I feel strongly about increasing the frequency of science teaching and improving the quality of science education at the elementary level.

I do not intend, however, to minimize the importance of discussing all educational levels involved with the science and math dilemma.

I have a question about the composition of the panel which determines the scholarship criteria in section 2(A) of title I. Perhaps this can be specified more clearly and can include representation from the teaching ranks.

With regard to title I, Roman numeral VII, I would like to see a component built in to perpetuate the funding after fiscal year 1987. This might include a requirement that a State funding network be in place by that date. Otherwise, the intent of this bill will be vio-

lated and become a very temporary bandage to the problem instead of a long-lasting cure.

Furthermore, in these economic times, I think this bill has very realistic financial figures. Science is important for all students. As adults, we expect them to function in a society that will call on their basic process skills each day of their lives. Making intelligent decisions, observations, and problem-solving are just a few of these critical skills.

Basic scientific and technological literacy will be required to operate in our world.

STUDENTS WITH BASIC SCIENCE SHOW BETTER ACHIEVEMENT

We know that students who learn basic science skills show better achievement in all academic areas because they have been given the basic tools of education for life.

Research indicates that it is most critical to instruct 10 to 15 year-olds in the scientific process. For most, this is their first experience with science. Their success at this level will determine their readiness for other levels of science education. Also, the foundation for scientific literacy is set.

We know that early adolescence is the best time for the establishment of lasting attitudes and beliefs.

Yet most emphasis on science education is being placed on high school age students. Secondary schools are seeing an increased enrollment in science courses.

REASONS STUDENTS TURN OFF SCIENCE

One could speculate that students are sensing the need to gear up for high technology. However, secondary teachers frequently complain that students come to them ill prepared to take their courses. We know that four out of five students have been turned off to science by the time they leave elementary and middle schools.

I believe the reason is clear. Our priorities have not included science education at the elementary level. Until this fundamental need is met, we will continue to slide out of our position as a technological world leader.

While there are some exemplary elementary science education teachers in the field, I think it is fair to say that most teachers at the elementary level do very little science teaching in their classrooms. Because so many of them have received little or no training, they do not feel comfortable teaching it. Other curriculum areas are considered to be more important.

On those occasions when science is taught, it is frequently taught only from a textbook and does not include experimenting and critical thinking skills.

I am frequently asked by fellow teachers for help in structuring and implementing their science programs. This explicit need can be met with teacher in-service training, provided there are funds with which to work.

Teachers have also had to be very resourceful to obtain adequate science materials. We frequently borrow, share or do without these tools.

While this is sometimes necessary, it is just one more factor that contributes to the frustration of any teacher trying to attempt science experiments.

As a member of the science curriculum-writing committee in this district, I know that considerable time and effort was spent writing activities for teachers that would focus on process skills so that teachers would get over their fears of teaching science. However, more time and energy needs to be devoted to this area before teachers are going to make significant changes.

OPPOSITE EFFECT FROM BACK TO BASICS

In my 8 years of science teaching, I have not observed any positive changes in the amount of science education that occurs in the elementary classroom. In fact, the return to the basics push has had the opposite effect.

An important place to begin to affect change is at the university level. I have had the opportunity to serve as the Las Cruces public school's representative on a College of Education committee at New Mexico State whose charge it was to redesign the undergraduate teacher preparation program. I am pleased to report that this issue was addressed by that committee.

The new curriculum will contain two science content courses and a full block of science and math methods courses. These will be required of all elementary teaching majors.

However, I must also sadly report that the College of Education currently reports that it is only enrolling one or two potential math and science teachers yearly. It is evident that this problem needs to be addressed.

EDUCATIONAL STANDARDS BEING REVISED

Our State Department of Education is currently revising the educational standards for New Mexico. At hearings last week, administrators throughout the State expressed their concerns regarding the 2-year math and 2-year science requirements that were proposed.

The basic concerns seem to be the lack of funds to provide additional lab space and equipment and the lack of science and math teachers. Also mentioned was the inability to keep good science and math teachers on board.

It is my hope that Senate bill number 248 will also help alleviate this situation. Financial constraints should not dictate the caliber of our student product at the exclusion of basic science literacy.

As a member of the Science Education Advisory Committee to the State Department of Education, I have the opportunity to speak to other science educators throughout the State. I was surprised to hear about the troubles they have in their district with the advent of the computer. All levels and districts are purchasing equipment that is being dumped on the teachers with little or no training in many districts.

It seems that many of the budgets allowed for the purchase of the hardware with little regard given to purchasing software and training teachers with fundamental skills at best.

A more systematic curriculum designed as needed and careful review of available software is also critical in the development of an overall computer curriculum plan. Unfortunately, State funding for these needs at present looks grim.

This is another area that needs support.

I am aware that you are in touch with the very real problems in science and math education as you so aptly expressed in your floor statement to the Senate on January 3, and today in your introduction. This bill indicates a real commitment to include the quality of education in these fields.

I am glad that Federal leadership is addressing this crucial educational need. I am equally grateful that you are seeking input from professionals in the field and that I have had the opportunity to be heard.

Senator DOMENICI. Thank you very much. Let me ask you with reference to the college curriculum——

Ms. SISSON. Yes?

Senator DOMENICI. Have there been some changes as a result of the committee which you referred to in the curriculum here?

Ms. SISSON. Yes. Dean Byrne showed, I think, great foresight and leadership in organizing the committee. I think some teeth have been put into the teacher preparation curriculum.

HOUSE AND SENATE BILLS SIMILAR

Senator DOMENICI. Vodene, I want to tell you that I asked my staff, why Chairman Perkins spoke so favorably regarding my bill, particularly in light of the funding differences.

I am informed that the bills are only about $50 to $70 million a part in their funding for elementary and secondary education. NSF is not included in his. We have a difference of opinion on this but I would assume that that has more to do with the House committee structure then on the merits of the issue. I have already heard from all sides on whether NSF should be in, or out.

And then there is a difference in how much goes down to the local school board and how much stays at the State level, so I am very hopeful that we can get the Senate Education Committee to focus on something in this area.

But in this area I think the Chairman of the House Committee is fully aware that if a group of Senators like myself can get something like this through, we are not going to have such big differences in conference and we will get the President to sign something.

Ms. PATTERSON. I understand that. Thank you.

Senator DOMENICI. Herb, you are welcome and we look forward to your testimony.

STATEMENT OF HERB HAMMOND, CHAIRMAN, MATH AND SCIENCE DEPARTMENT, ALAMAGORDO HIGH SCHOOL

Mr. HAMMOND. Thank you very much, Senator. And I appreciate having the opportunity to be here and have some input.

I concur wholeheartedly with what my two colleagues have said prior to this and they have said many things that I wanted to mention so I am going to carry on with some other points.

I am very much concerned with the educational process and I am afraid sometimes that we are not going to see any major improvements in the schools until parents, teachers, and local administrators and students themselves personally understand the problems themselves and demand a higher level of performance.

SOUND ELEMENTARY EDUCATION VERY IMPORTANT

I am particularly appreciative of the fact that you are giving thorough and serious consideration to providing first-rate instruction in the classroom K through 12. Many times, being in the secondary level myself, I have a tendency to think in that level and of course, I am corrected on that immediately, my wife being in the elementary level sets me straight right away. From the secondary standpoint it is very difficult to teach math or science when students do not have a proper reading background, in particular, or math background.

Therefore, I want to again reiterate and stress the absolute importance of a good, sound elementary program. It is cardinal. These are formative years. These are the years that develop our students. We develop them not only in their cognitive skills but also in their enthusiasm for continuing along in the area of math and science.

I wanted to deviate for a moment, if I can, to point out some of the current struggles that are going on. I would like to mention to you here some of the problems that we have and I am taking them from a personal situation out of our school because I want to place emphasis on them and I know that they are true.

HARD TO GET STAFF LOST BECAUSE OF SALARIES

In our science and math department, with a faculty of nine, in 1981, we lost three people, turned over because of salaries.

Senator DOMENICI. Now let us state for the record, your position you are the chairman of the math department at Alamagordo High School——

Mr. HAMMOND. Math and science department.

Senator DOMENICI. Math and Science Department. And you just stated you had nine?

Mr. HAMMOND. Yes, out of nine last year.

Senator DOMENICI. All right.

Mr. HAMMOND. Out of 10, in 1981–82, we lost four.

One of the struggles that we are confronted with, of course, naturally, is salaries. We have lost a lot of very splendid teachers whom we have spent a lot of time and effort seeking out, hunting, and finding. It is very difficult in this day and age to find qualified math and science teachers.

The colleges of education and all of the State schools have been most helpful but there just is very little there for us to draw on. They just do not have them available. That is all there is to it.

LOW TOLERANCE FOR DIFFICULTY OF THE PROBLEM

So in looking at this short-range program which we have to solve immediately on a day-to-day basis, we have been forced to look at another situation in the secondary program and we have had to go

to private industry to look for people who are retired who would hopefully accept a position if they had the qualifications.

And looking at their qualifications sometimes in private industry we found some private people that were well-qualified but when they got into the nature of the educational process, they had a low tolerance for the difficulty of the problem and they abandoned the idea immediately. [Laughter.]

SUCCESS WITH RETIRED MILITARY APPLICANTS

Fortunately, we have been more successful in other areas. We were able to, out of 15 applications from the select group of the highly trained military officers in the area that we have at Alamagordo and Holliman, we were able to look at some good applications.

Out of this group, we were able to find some retired personnel who had excellent qualifications and I would like to report, out of a large number of those we found two or three that turned out to be exceptional. We were just very, very fortunate, very fortunate. When dealing with the immediate, crucial problem, we are left with this situation. These people can teach because they have another income and they have the freedom, also, of not having to moonlight on the side, which gives them a very distinct advantage in the classroom in that they can put all of their physical strength, body, mind, and soul, into the preparation of their work.

Not that, do not misunderstand me, not that others do not do this. But sometimes in the long hours of the day, your physical strength runs down.

Senator DOMENICI. Yes.

Mr. HAMMOND. I would say to those people that I have had the unique opportunity of working with throughout the State in the Science Advisory Board, the New Mexico Academy of Science, I have found a very unprecedented situation in the State of New Mexico.

Some of the people have, I would say, 10 years or more tenure and are people that are devoutly committed to the sole purpose of educating students in the State of New Mexico. I think they are exceptional. I hope they will have the fortitude and the endurance to continue on for another 10 or 15 years but that remains to be seen because the educational process in the classroom is rapidly changing and it is a real battleground right in the front.

Very briefly, I would like to go to a couple of other different points while I may that may not have been covered.

The professional organizations in the State fortunately are relatively strong and they help support and give new morale and new strength to those of us that are on the battlelines every day and I commend those people who, year after year, continue to put on many programs under very hazardous conditions in moving about the large State.

I want to mention here something, a word or two about training, if I may. I want to mention something that was brought out earlier in the program and I think that we have an opportunity to hear about and explore some unusual things in service training and

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moving a unit that is highly trained from one part of the State to another.

Dr. Smith pointed out to you the extreme difficulty of moving teachers to these centers. The travel at that time was so difficult. It is even more so now. But this has a unique idea. It is one that is strong and one of the fine points about it is, you get a consistency of quality with this kind of a program.

I would like to mention a couple of other things that are going on throughout the State.

EXELLENT TRAINING PROGRAMS

The New Mexico Academy of Science, I am sure you know about this but I would like to be on record as saying something about it, offers a summer science training program for students, high school students, juniors, from grade 11 and on and we take approximately—there are two sessions of 3 weeks and there are approximately 32 students that go to each one of these programs during the two 3-week periods.

This has been going on for about 18 years and the programs rotate from university to university throughout the State. They are confined only to State institutions.

This has been a very excellent training program for high school students and here we are putting, the State is putting some money back into its youth and I know that it is greatly appreciated.

Currently, the New Mexico Academy of Science is attempting to address and look at a similar kind of a program, they are studying it for developing a teacher summer science training program for a few short weeks to at least get teachers updated on some current concepts in science.

It is difficult, at the very best, for most teachers to keep abreast of the vast amount of current changes that are coming along in science and math from day to day. It is almost impossible when you think of the number of hours that we spend in grading papers and trying to keep abreast of research articles; it is rather difficult.

This is why the reinforcement from the kind of a program where we might have a special unit coming in and giving instruction to teachers in a particular area would be most beneficial.

INDUSTRY COULD GET TAX BREAK FOR TRAINING

Another thing you mentioned earlier, you referred to some special seminars that were provided by various governments and no, private industry. A number of years ago, these were put on and they were very outstanding.

One of them was sponsored by Kenicott a number of years ago. It was a very outstanding institute. There are a number of others that have gone on in the area of energy, many of which I will not mention right now but these people should be encouraged and an incentive should be provided for private industry taxwise if possible to allow them to continue this kind of instruction.

UNIVERSITIES COULD HELP WITH TRAINING

I would make another recommendation here if I may; the universities in the State of New Mexico are geographically situated so that probably most of them could to some degree accept people on a travel basis into their area without too much travel and too much difficulty. They provide a Saturday or two where they could offer some updating in four or five areas of science. We have highly skilled people with excellent educational background here.

It would be a matter of them wanting to do this. Some universities have done it throughout the State and these programs have been outstanding and I would recommend and encourage them.

In conclusion, I want to say one other thing. We have the greatest resource in this Nation with our young people. And it is truly appalling to me that we as people, mature people, have the inability to properly assess and evaluate the educational opportunities and skills that are available in this country.

I am constantly alarmed at the indifference that parents, in particular, take sometimes—not all parents but some of them take toward the educational process; assuming responsibility and seeing that children have a commitment and make that commitment which will enable them to become better citizens and qualify them for better skills.

I wanted to particularly thank you for one other thing in your program that you are outlining. You are attaching some commitments, personal commitments to these people who receive educational benefits. I think this personally is excellent.

People that serve in the military have the opportunity to go to the Academy and have a commitment. When they get through, they are required to put in a certain number of years for the educational opportunities that they have.

I think this will help those people who have 5 or 10 years into the educational program right now. They put a lot of time into it. They have a vested interest in the program and they know what the game is all about and they have the fortitude, the desire and the determination at this particular time and the knowledge to really go forth and be extremely productive.

Thank you again for the opportunity.

Senator DOMINICI. Thank you. Before we get to Mr. Vega, let me say that, while I have not arrived at a lot of real conclusions about changes in the legislation, I am firmly convinced already that the part of the program directed at getting more young people to go into a college of education and seek a math and/or science certification, for lack of a better word, I am convinced that more resources have to be put into that, rather than less. I would almost say, even at the expense, even at the expense of lowering the block grant for awhile and emphasizing the other. While some of the teachers may be short term, may only spend 5 years, others may like it and, to borrow your word, get "hooked." Obviously in my own State, I am no longer worried that if young people go through this kind of training, that there will not be a job in the school system.

THERE WILL BE JOBS FOR THE MATH AND SCIENCE EDUCATED

There are a lot of young people not going into colleges of education because they are being counseled that there are no jobs in teaching because of the demographics and lots of other things that are happening. But I am confident, from what I have heard, that would not be the case in math and science and I think we ought to go as fast as we can there.

That does not mean that is the only long-term answer but surely you epitomize it. You found a way around it. Just think of how many schools do not have what you found there to experiment with. I mean, there have just got to be literally hundreds of schools that could not find a group of retired military scientists and mathematicians that like the community and are interested in becoming teachers.

But where are we going to get them? We are just going to have big voids, it appears to me. I have already arrived at that conclusion. That scholarship program is inadequate. We have got to find something else and maybe it is a loan forgiveness, program maybe it is a loan program that we can recommend nationally or urge the State to set up and then attach to it requirements that they serve for some period of time.

Would you agree to that?

Mr. HAMMOND. Very much so. I would. I have two other comments, if you please.

Senator DOMENICI. Sure. Of course.

Mr. HAMMOND. I won't take but a minute on them.

My colleagues asked, before I left, that I bring to your attention that throughout the universities, particularly in New Mexico, we have superior people.

But our secondary and elementary people would like to have the opportunity to meet these people who are the excellent teachers rather than being placed in the position of having a graduate assistant who really does not know their problems.

Second, I want to thank you for bringing this to the national forefront here this morning. I have probably done a lot of laundry. We have done a lot of washing and——

Senator DOMENICI. That is great. That is what this is for.

Mr. HAMMOND [continuing]. That is part of the game and I am very proud of my profession. I am delighted to be a teacher. I made a commitment at it and I have sold my daughter on the idea and so that I think that we can go on down the line.

Senator, you have a real tiger by the tail with this one. We wish you well and we thank you for your devotion and your expertise and your continual work on this program. I know that you are going to meet with a great deal of opposition but we support you here in our State and we very much appreciate what you are doing.

Thank you.

Senator DOMENICI. Thank you.

Fred.

STATEMENT OF FRED VEGA, PRINCIPAL, SILVER CITY HIGH SCHOOL; AND MEMBER, BOARD OF DIRECTORS, NEW MEXICO ASSOCIATION OF SECONDARY PRINCIPALS

Mr. VEGA. Thank you, Senator. Besides being the high school principal in Silver City, I also serve on the board of directors for the New Mexico Association for Secondary School Principals, so I am pleased to testify here today before you on their behalf as well.

Senator, the principals of the State of New Mexico share your concern for the status of math and science education in the public schools. Our schools have been plagued with many demands; one of them being viable programs in the basic skills area.

Of course, the big problem to us is creating viable programs in math and science. In talking to many principals across the state it is becoming increasingly difficult to develop strong programs in science and mathematics. To us, the problem is very clear.

DRAMATIC DECLINE IN MATH MAJORS

The number of students entering math and science programs in college is decreasing every year. Scott Thompson, the executive director of the National Association of Secondary School Principals, tells us that the 1980 study of probable majors of entering freshmen in higher education indicated that in 1970, 52,400 college and university freshmen planned to major in mathematics.

The number declined in 1980 to 10,250. This amounts to an 80 percent decline in the number of college freshmen planning to major in mathematics.

Dr. Thompson also indicates that between 1970 and 1980 there was a decline of 58 percent in the number of earned bachelor's degrees in mathematics and a decline of 36 percent in the number of physics degrees earned.

I might add here that, in my school, it has taken us 3 years to find a certified teacher in physics. The last one we had was employed by Los Alamos Scientific Lab.

DECLINE CREATES PROBLEMS FOR SCHOOL SYSTEMS

The decline in math and science graduates creates the following problems for our schools. First of all, schools must request temporary and emergency certification for teachers having limited backgrounds in these areas.

Second, in many instances, substitutes must fill positions until certified personnel are found and this is not uncommon for many of our schools, especially our smaller schools.

In our district, teachers in science and math have to have multiple endorsements in order to teach in those areas and it is very difficult for them to fill those positions.

Third, the lack or the loss of qualified personnel makes it difficult to develop programs at all grade levels or, through the lack or loss of personnel it makes it difficult to coordinate and implement programs at all grade levels.

Definitely, the lack of strong programs makes it difficult to motivate students to seek careers in math or science.

I think our young people like to see models that they would like to follow and when we do not have people that are enthusiastic about what they are doing, and they are placed there because they have a limited background, it makes it difficult.

Senator DOMENICI. You mean the teachers themselves?

Mr. VEGA. Right.

Senator DOMENICI. The role model.

Mr. VEGA. Right.

Senator DOMENICI. Also, there are a lot of scientist role models in the country and they are extremely excited. The thing is that their excitement is not getting down to the students, which I am going to ask a question about in a minute.

Mr. VEGA. And the sixth concern is that the student community needs are not met. If the public schools are to meet the technological challanges of the future, it will be imperative that programs be developed to encourage young men and women to enter the teaching profession in the fields of mathematics and science.

It will also be necessary for school districts to compete with private industry in the recruitment of talented men and women.

One personal concern that I have is something that Dr. Byrne alluded to in his presentation, which is, what the role of the public school is.

DETENTION CENTERS FOR UNWANTED CHILDREN

Is it a detention center for unwanted children? Or is it an institution where teachers have the ability, have the time and have the resources to teach these young people?

One of the problems that we have, I feel, is that there is a lack of leadership, curriculum leadership, in the buildings and this, I feel, is because those people that are paid to be curriculum leaders in their buildings, have to serve as part-time lawyers, part-time detectives, part-time disciplinarians, part-time family counselors. If you look at and talk to principals across the state, you will find that the concerns and the discussions that they have with each other often do not deal with curriculum matters.

They deal with how to handle vandalism, how to handle discipline problems, how do you protect yourself against law suits and matters such as this.

This hinder development of programs in the buildings themselves until such time that there is somebody to define what the roles of the schools are going to be and sees to it that those roles are carried out.

In conclusion, on behalf of the New Mexico Association of Secondary School Principals who would like to applaud you and your staff for your interest and your concern in working with these problems, thank you.

Senator DOMENICI. Thank you very much.

Let me give you two examples that popped into my mind and ask you what you think, Vodene, since you are the head of the NEA in New Mexico.

I was at a little grade school in Albuquerque a couple of days ago called East San Jose Grade School. That part of the school system in New Mexico responded to the national school lunch program in a rather different way than many have. They decided that, because

of one parent who got very interested in what was put on the tray to feed the children, that they were going to get together and work on having less plate waste. We hear so much about administrative waste. It was obvious to all, that there was a lot of plate waste because the kids would not eat the food that was being served, because it was not very good.

This actually happened to me. I sat at a table with first graders and the lunch consisted of pizza made a little differently, since the crust was whole wheat, a salad, an oatmeal cookie, three fresh slices of orange and a little package of milk and it skim, it did not even have fat in it. And it certainly was not chocolate.

Would you believe that a little girl sat across there and said, as she drank her milk, "I don't drink chocolate milk any more. I like white milk."

And that shocked me. I said, "Why is that?"

She said, "Because the teachers have been telling us what is good for us and chocolate milk has too much sugar in it and I don't drink it any more. I get my sugar from the orange."

Now, that is a first grader, 6 years old.

You recall, back about 12 years ago, there was a great national effort not to be litter bugs. Remember? Cities all around the country put up litter boxes. At that point in time, my recollection is, Frank Sinatra was more popular than today. He is only popular now with some of us old folks.

But somebody got Frank Sinatra to sing a very catchy tune called, "Don't be a litter bug." Maybe you all remember it. I remember it as if I could hear his voice.

I was standing on a street corner in Albuquerque when I was mayor and we had a litter box up and three 14, 15 year-olds came along and they were very disheveled-looking. They probably should have been in school, considering the time of day. They were all eating Milky Way candy bars, as I recall. One had just finished and had the wrapper and one would have expected, just from looking at things, that they would have thrown it on the sidewalk. You know what happened?

As they passed that box, one of them spontaneously started to sing Frank Sinatra's tune, "Don't be a Litter Bug," and put the wrapper in the litter box.

ROLE OF PUBLIC BROADCASTING IN EDUCATION

You know, we have public broadcasting. While there are some complaints around that it has been cut, it is in pretty good shape. I think the funding level is pretty high. It is about $130 million and it will be there for 4 or 5 years.

I wonder if public broadcasting has a role in broadcasting some kind of regular, exciting program for the very young about science. Are they doing that? Are we doing as much as we should? And is that the kind of thing that would be helpful at the elementary level? I know they all like to watch certain kinds of programs.

In fact, Congress has looked into that because sponsors of food that are not so good for kids advertise on television and are convincing kids to eat the wrong food.

Could you just comment on that?

Ms. PATTERSON. In the public schools?

Senator DOMENICI. Is there some way that we could all be helpful in creating the right kind of attitude. Science is exciting; the kids are all experiencing science by getting involved with Atari and other computer games. That is science and math and yet somehow, the kids are not exposed to the theory behind the games.

Ms. PATTERSON. They have not made the connection mentally between what they are playing with and what the process is.

Senator DOMENICI. Right.

PROGRAMS SHOULD BE FUN FOR CHILDREN

Ms. PATTERSON. Yes, public broadcasting does do some shows in this area. Of course, I never believe that anything does enough, as you can tell.

Senator DOMENICI. Of course.

Ms. PATTERSON. So I think more could be done in that particular area. You are correct in that children do ape a role model and I do relate to Mr. Vega's need to have a role model in the classroom.

Senator DOMENICI. So it would be appropriate for me to ask them nationally how much they do and whether they work with exciting people to make a program that is fun and exciting? And you were telling me it should not be for seniors. It should be for third, fourth, and fifth graders, as I understand it.

Ms. PATTERSON. I would suggest even preschoolers.

My children came into school able to do math because their mother taught them math concepts from the time they were babies and they could develop negative numbers by the second grade on their own. They had the concepts there already.

So I am saying that it should be targeted, not only for school age, but even for younger children. And also, it should involve educators. Too many programs are devised on public broadcasting by people who think they know how children think.

Senator DOMENICI. Right.

Ms. PATTERSON. And that is one of the things you probably learned in teaching. Not everybody knows how a child thinks. They do not think like a little adult. It is a different world for a child.

Senator DOMENICI. Yes. Do any of you have any observations? Yes, Fred.

NATIONAL NETWORKS COULD HELP

Mr. VEGA. I think the major networks can also do more than what they do in this area. Especially in the area of replacing some of the so-called children's programs on Saturday mornings. I think that they should substitute some more worthwhile programs than what they have.

Senator DOMENICI. I do not want this to be construed as Domenici's hearing on broadcasting and taking over and telling the networks what to do but that is a very good observation.

Herb, do you have any different idea?

Mr. HAMMOND. No; it would be nice to see some of the unusual programs that were going during the Sputnik era.

Senator DOMENICI. Got it.

Ms. SISSON. There are a couple of programs. Cosmos, I know, received a lot of attention from my students.

Senator DOMENICI. Yes.

Ms. SISSON. There is another program, the title is escaping me right now, that is a relatively new program, last year, that deals with science.

Computer programs, that you mentioned, do get the kids involved. I think computer software is improving daily and I think that they are aware of and are working on developing software that teaches, not just a one-on-one interaction, but teaches how it works and uses that high interest to advantage. I do not think we are quite there yet but it is getting better.

Also, there are a couple of magazines that come to mind. World Magazine, put out by National Geographic, is a very high-interest magazine for elementary-age students. And the science magazine, Discover, has also—I have a lot of students, accelerated students, using that magazine.

Senator DOMENICI. Thank you very much.

All right, we will take our second panel now. Dr. Kenneth Ladner, dean of college of science and math at Western New Mexico University; Dr. Mary Atwater, associate director, Southwest Regional Resource Center, professor of the department of instruction, New Mexico State; Dr. Irwin Vance, associate professor of math, New Mexico State University and Dr. George Mehaffey, director of the school of education, Eastern New Mexico University.

All right, Dr. Ladner, do you want to proceed?

STATEMENT OF DR. KENNETH LADNER, DEAN OF COLLEGE OF SCIENCE AND MATHEMATICS, WESTERN NEW MEXICO UNIVERSITY

Dr. LADNER. Thank you, Senator. One problem with being on panel No. 2 is that many of the good parts have been covered by members of panel No. 1. In the interests of time and to avoid redundancy, I would simply state that I support many of the concerns spoken to by Dr. Byrne and Dr. Smith.

Then you moved panel four ahead of panel No. 2 and I had to delete even more of my text so, perhaps this meeting could have been shortened considerably had you made one more move.

But I think what this amounts to is that many of us here today can voice pretty much the same concerns and problems. They are the same over the State and on a National basis, too.

And for a problem to become a crisis, this time has certainly arrived. First come the scattered warnings of impending trouble from those closest to it.

At that early state, nothing much else ever happens. As the problem gets worse, the screaming gets louder, loud enough to gain the notice of people who, although not actually at the scene, nevertheless have an interest in the matter.

Finally, if the problem gets bad enough and if the complainers are persuasive and persistent enough, it draws the attention of politicians and journalists. Then it becomes a bona fide crisis.

Now, I am relieved that we have finally gotten the attention if those who really can effect positive changes.

I enthusiastically applaud your effort to help solve the current crisis in science and math education and support your bill and would like to make a few comments pertaining to that bill.

Many of my colleagues feel that, in title I, the administration of the scholarship program by the National Science Foundation is a definite strength. Concerning title III, we do express some concern about block grants. We do feel that block grants have many advantages.

NSF RECEIVING LOT OF FLAK

They allow States to set their own direction and while this is desirable to some extent, the question might be, should not an agency such as the National Science Foundation be given a little more clout in determining the course of the country pertaining to math and science education?

Lately, it seems that the National Science Foundation is receiving a lot of flak. There are, among those in the administration, many others who mistakenly believe that science education has received substantial support, especially in recent years and that since we now see all of these serious problems, the infusion of massive Federal support has been a failure.

Instead, if we look at the figures, we see that the National Science Foundation support for science and engineering education has been declining steadily and steeply for the past 22 years.

Science education's share of the total national Science Foundation budget dropped from a high of 47 percent in 1959 to a current low of 2 percent. .

Support for precollege science education dropped even more sharply, from 72 percent of the science education budget in 1959 to only 22 percent in 1980.

In terms of the total National Science Foundation budget, the precollege share has dropped from 34 percent in 1959 to its present low of less than 1 percent.

ELEMENTARY STUDENTS THINK MATH IS DULL

The final thing I would like to say is that we can look at all the numeruus figures and percentages and make projections and we can make elegant speeches concerning teacher and student motivation but the bottom line is in the nuts and bolts application, we believe, at the elementary school level.

We believe that it is between grades approximately 2 to 5 that many, many students determine, either from their teachers or from their peers that science and math is hard and dull and dry and in reality, it can be made very exciting and so we think some efforts need to be made in this direction.

Thank you.

Senator DOMENICI. Thank you very much.

I would say that we were really quite pleased, in looking at the NSF's budget this year. The increases are rather dramatic. Perhaps they are not going to redress the percentages as dramatically as you might like because the number of other functions where NSF is not in science are increasing also.

TALENTED PEOPLE BECOMING MEDICAL DOCTORS

But let me suggest that every place we looked in the broad area of science, we have a concern on the part of the great scientists of the country. It is not only in the area we are talking about here. We have some who are saying, for instance, of the supertalented young people that go through our colleges and get scientific degrees, whether they be in biology, or physics, or chemistry, are too large a percentage of those students going on to be medical doctors, because that is a very sound and stable economic life? Are too few students going into basic scientific R&D?

We have a whole arena of concern as to the young postdoctorate researchers in science and math and physics. That is kind of a strange period for them if they want to remain academicians and researchers.

Of course, postdoctorate researchers have the choice of getting out of the basic R&D fields NSF is aware of these problems and the National Academy is also aware of them.

Some are being addressed this year. The Federal energy budget has an exciting $6 million increase and we hope we can devote it to postdoctorate fellowships in the national labs. A rather significant stipend could encourage young people to remain basic researchers.

Certainly there are not enough academic positions in colleges. I understand the administration may recommend, although I have not seen it yet, a rather large number of stipends for young doctorates to stay on campus in schools of science and engineering for an additional period of time when they cannot get an associate professorship. So there are a number of proposals to deal with this broad issue.

I appreciate your comments and thank you for coming.

Dr. Atwater, tell us what you do. I read your title.

STATEMENT OF DR. MARY M. ATWATER, ASSOCIATE DIRECTOR, SOUTHWEST REGIONAL RESOURCE CENTER FOR SCIENCE AND ENGINEERING; AND PROFESSOR, DEPARTMENT OF INSTRUCTION, NEW MEXICO STATE UNIVERSITY

Dr. ATWATER. Senator, I am the associate director of the Southwest Resource Center for Science and Engineering. That is an NSF-funded program to encourage minorities to pursue careers in science and engineering and also I am assistant professor in the Department of Curriculum and Instruction. And I am a science educator.

Senator DOMENICI. So you work in that program that Dr. Griego——

Dr. ATWATER. Dr. Richard Griego.

Senator DOMENICI [continuing]. Is the head of.

Dr. ATWATER. Yes; this hearing has been called to focus on the imortance and significance of math and science education in America. There has been an increasing concern on the shortage of scientists and engineers and this concern has led to the consideration of the shortage of mathematics and science teachers in the United States.

QUESTION RELATING TO THE PROBLEM

In order to discover the solutions to these problems, there are several questions that must be asked first.

They are: What is science? Why teach science in the public schools? Who should be enrolled in science classes? Who is accountable for the quality of science instruction in the public schools? How is science now being taught in the public schools? What are the problems in teaching science?

Why do science teachers decide to leave the public school system? And why are high school students not considering careers in science teaching?

Many may ask, Why is the question being asked, "What is science?"

Science is viewed very differently by many people and people's perceptions will influence the answers to the other questions.

Science is not a stagnated body of knowledge to be handed down from generation to generation. One person has defined science as, "The wisdom to know that the wisdom that is passed down is not wisdom."

Let us assume we can come to a consensus about what science is. The next question is, Why teach science in the public schools?

I believe that the overwhelming reason why science should be taught in the public schools is because we want a scientifically literate populace in this country.

FUTURE JOBS WILL REQUIRE SCIENCE AND TECHNOLOGY KNOWLEDGE

In the year 2000 it will be necessary to have a knowledge of science and technology to obtain a job. And I am not talking about a professional job.

Many will not pursue careers in science and engineering or mathematics. However, we need people who understand enough about science to make intelligent decisions about science and technology questions.

As a matter of fact, Shirley Chisholm stated in an address that she made to the National Science Teachers Association, that—

> Even in the United States Congress, that bee-hive of intellectual activity, we are poorly prepared to address these issues. About half of all the bills we consider have a major technological component but only two of my colleagues have had formal training in engineering; even though many more of us did sweat our high school science courses, I doubt that we have a good grasp of nuclear fusion or genetic engineering.

This leads to the next question and that is, Who should be students of science? And I maintain, all students. The exceptional student which includes the mentally retarded all the way up to the gifted.

The minority student regardless of whether they are Hispanic, American Indians, or blacks; the average student should be enrolled in science classes.

No student should be excluded from science instruction.

And who is accountable for the quality of science teaching?

Many would say teachers and principals. But I say there is a host of people who are responsible for that quality.

The school board, principals, teachers, counselors, students, and parents of students. With the exception of those people who are employed in the public school system as educators, the usual qualification to be an expert in education is that you must have attended public school and have children now attending public school and that, I very much disagree with as far as being an expert in education, to only meet those two qualifications.

STUDENTS LEARN SCIENCE BY DOING SCIENCE

Science is now taught from elementary to high school as a knowledge-acquisition set of courses. Recitation and lectures are stressed in the higher grades. And why is science being taught this way?

We all know from the 1960's that science was supposed to be a human endeavor in which inquiry, seeking of knowledge, asking of questions should be involved and yet now we see textbooks being the sole source of science information in the public schools.

In the high schools, teachers usually have a very strong background in their science content area so they are qualified as far as science content area.

Many times they lack the equipment and supplies necessary to do laboratory work. Students learn science by doing science, not by reading about science.

Many junior high school teachers also use textbooks. Their problems usually are twofold, lack of equipment but many times lack of science knowledge. And these two can be overcome. However, it will take more effort than some people are willing to do.

Little science is taught in elementary school and the reason why is that elementary teachers fear science. They will tell you that they are trained to teach reading, writing, and arithmetic. They do not know anything about science.

And as a result of it, they teach very little science.

When my daugher comes home and tells me she has had a science lesson today, I ask her, what did she learn?

She says, "We took out our science book and read on," I think that particular day, the Moon, the stars and the Sun. And that was all. She is learning that science is nothing more than just a body of knowledge that is to be handed down from generation to generation.

Elementary teachers lack science methodology courses along with a lack of science knowledge and I firmly believe that in order to teach science in the public schools, you must develop a philosophy of science teaching. Elementary teachers do not have this because they have not had a content background nor do they love science enough to develop such a philosophy.

With all these obstacles, it is amazing that we actually have science instruction in the public schools.

LACK OF SUPPORT CAUSE TEACHERS TO LEAVE

Now, you now ask the question, Why do teachers leave the public schools?

Some say it is because of salary. And I agree. But there are other reasons why teachers leave the public schools and it is lack of support.

Who wishes to come home and grade papers? Very few faculty members at university grade papers. They have graders.

If you are a science teacher and you want to be involved in laboratory work, you must prepare the solutions. You must find the specimens. You must put together the laboratory equipment.

You must then take down the laboratory equipment, put that away. And that is a tremendous amount of work for one person to do for five or six science classes per day.

And I believe that if we can provide the clerical support so that they do not have to type their own exams, even if they have to grade their own exams, but also provide lab assistants for these people, I believe that many of them would be more willing to stay into science instruction.

Then, of course, we have the problem of "burn-out."

Many teachers come, very enthusiastic. They work very hard. Five years later they are burned out and physically burned out as well as mentally burned out.

We say that in any organization we have attrition. However, usually that is taken care of by new professionals coming into the field. But this has not occurred in science education.

Students are not considering careers in science education because, first, they have been told that there is an oversupply of teachers, that the pay is very poor and they can do better if they can go into industry and that many times, science education programs are very rigorous.

Not in this State, but in another State where I was a student, 50 percent of the students who were prepared as math educators never will see the public's classrooms. Industry has already gotten to them.

Also at this particular school, where we had people who majored in physics and chemistry, those people never saw the public classrooms. They can make much more money in industry and that is where they went.

STUDENT SCHOLARSHIPS CAN HELP

What are the viable solutions? The Senator has proposed student scholarships, teacher's awards and block grants to the States. Student scholarships can serve as an incentive.

However, the amount is small. The number to be awarded is small. And in addition to it, when will these scholarships be awarded? Junior-sophomore years? Or junior-senior years or when?

Also, as far as the teacher awards are concerned, they do motivate teachers but you still have not considered the question of burn-out. These teachers can be motivated. They can say, "OK, I will work very hard and I will get this financial incentive." But unless they get the support that is necessary, we are still going to have to be concerned about the burn-out problem.

We need to realize that science instruction is expensive. Universities realize that. They must spend a tremendous amount of

money on science instruction, chemistry, physics, engineering, biology. We must have laboratories. We must have equipment.

And I believe that the public schools must agree that science instruction will be expensive.

Block grants are to be given to States and this may be a satisfactory way to meet the States' specific needs but many times States lack the science staff necessary to determine the need and then to distribute the money.

Any math and science education program in the State should include the economically disadvantaged, as you have outlined in your proposal.

Now, you have included Hispanics and American Indians. However, you have excluded blacks and I definitely believe that blacks should be included in this special target group.

FOUR-YEAR DURATION OF BILL TOO SHORT

The funding for this bill is for approximately 4 years and it usually takes 1 year to set up a program, another 2 years to make contacts and develop a network. And by the 4th year, you are ready to get into the business of the job.

If there is one thing we have learned in education, it is that we have not spent enough time on projects. There is a pendulum. We swing back and forth.

The resource center concept is an excellent example. The resource centers were funded for 4 years. It takes 4 years to set a resource center up and get it functioning properly but then, the money runs out and I truly believe that you should consider any bill that is to be passed to be longer than for a 4-year commitment because you will not have as great an impact.

And the other problem I have, and it has more to do with this Federal Government spending and that is, that we say we want to spread the money around throughout the United States.

However, many times in spreading out that money, we lose the impact that we wish because we have no network system set up to make sure that these programs are going on, people are knowledgeable about them.

And I think that is one of the pluses of the resource center concept and I would strongly suggest that you think of a way in which we can improve math and science education where there is a setting up of a network system.

Again, I wish to stress the fact that we must do something about math and science education in this country. It is not an easy task.

However, we must think long and hard on it because we just do not need a shot in the arm. We just do not need a fix for 4 years.

Thank you very much.

Senator DOMENICI. Thank you. Let me suggest to you on the one question you had about blacks. My staff tells me that the paragraph on page 9 labeled "D," that the language there is clearly intended to include all minorities or under-served populations. If you think that language is inadequate, well, then, we will look at it again and modify it.

Dr. ATWATER. Well, yes. I would strongly suggest that you modify it.

Senator DOMENICI. I agree. I agree.

STUDENTS COUNSELED TEACHING PROFESSION OVERCROWDED

Let me ask you this with reference to the concern that has been expressed here that if our young people go to look at a college curriculum and talk to a counselor, they are getting the answer generally that you described to me, that the teaching profession is overcrowded. Consequently, we have fewer and fewer students going into those schools.

If we had significant incentives, more scholarships or other financial remuneration, do you think that would be an enticement for more students to enter the colleges of education for math and science teaching, in spite of the national trend?

How else are we going to do it?

It is true that there are very few faculties in the United States and our colleges which are beefing up their colleges of education. Quite to the contrary.

Dr. ATWATER. That is true.

Senator DOMENICI. Because while we have not been very good counselors to our young people, we get them into fields of study and they may find out later that there is no need. Somehow or another, in education, the word is out, "Don't go to colleges of education because there aren't any jobs." And that is, at least, being told in many schools.

Would that change as to math and science if there were additional incentives?

COUNSELORS NEED INFORMATIONAL HELP

Dr. ATWATER. Well, I do not think additional financial incentives will do it. I think just getting the information to counselors that there is a shortage of math and science teachers in this country.

The resource center, if I may tell you this, sponsored a counselor workshop last year here at New Mexico State University. Counselors play an important part, as you know, in determining the courses that students take in high school and many of them, when they came here to New Mexico State University, said they knew very little about science and engineering, what the requirements were to major in science and engineering.

They were very shocked to find out there was a shortage of math and science teachers. And they said, "We need help" and pleaded for help from industry, the university, the State and the Federal Government.

WILL FINANCIAL INCENTIVES GUIDE STUDENTS TO MATH AND SCIENCE

Senator DOMENICI. Well, let me just digress for a minute.

Doctor, how many students do you have in your College of Education seeking to become teachers in math?

Dr. BYRNE. I believe five in secondary education in math and science.

Senator DOMENICI. Dr. Ladner.

Dr. LADNER. About one, I think. One or two.

Dr. BYRNE. Just as a matter of statistics, it is suggested that by 1985 there will be 185,000 jobs and 149,000 applicants.

Senator DOMENICI. Exactly. But kids either do not believe that or are not being told that. I have four in college all the time so I am an expert. The last one that went in was literally told, she was thinking of primary education and they were nice people, wonderful. They love her very much and they just said, "Are you sure you really want to do that? There really are not any jobs that are going to be available."

Now, she did not ask about chemistry or anything else. That was the first answer.

Do you think, before we have Dr. Ladner answer, that you would get more math and science students if there were financial incentives significant in nature?

Dr. BYRNE. I do. But let me give you one little anecdote. We were recruiting in the Santa Fe area this week and spoke with the valedictorian in one of the high schools in Espanola. Her interest was in becoming a math teacher and she definitely did not need the financial help. The financial help was available for her to come and study to be a math teacher. So for some students, certainly, it would help.

Senator DOMENICI. What do you think, Dr. Ladner?

Dr. LADNER. I think that would help to some extent. One of our problems has been, they go along in the educational program and then somewhere along the line they hear about all the opportunities that are available in industry in chemistry and math and so on and change directions.

Senator DOMENICI. Dr Vance. And then we will get back to some more questions.

STATEMENT OF DR. IRWIN VANCE, ASSOCIATE PROFESSOR OF MATHEMATICS, NEW MEXICO STATE UNIVERSITY

Dr. VANCE. Good morning, Senator. Generally, I applaud your b[illegible]. I think it addresses five areas which are essential. One is to encourage talented young people to enter the field of math and science education.

Second, is to provide more in-service training for current teachers, to recognize and publicize the outstanding achievement in the learning and teaching of mathematics and science, provide equipment and other resources for elementary students, secondary students, and for teachers of math and science.

And to encourage and continue work on curricula and materials. I think these are five areas in which we need work.

I would like to make some comments about certain provisions of the bill as I understand it. I think perhaps I may be somewhat limited in my knowledge of the bill from reading this.

I would certainly like to support the merit scholarships.

I think they are useful and I have the same question Dr. Atwater had about when they would be awarded?

Senator DOMENICI. Yes.

Dr. VANCE. I think it is essential that we have these commitments early to go into teaching.

It seems to me it might also be useful if there were some division for people at the graduate level who may have majored in some other area who might be encouraged to go into math and science teaching. But they would have to do the work at the graduate level. I think that might be a source that would be useful to us.

I think it is important that we recognize achievement in math and science and I would like to see some kind of comprehensive program to make awards to students at very early ages.

Some of my work that I have done in projects and inner city and rural areas shows that it is very nice when students know someone who has had an award or has been selected to go somewhere. This is a very useful thing. So maybe, in some way, we can build into this provisions to bring this down to a lower level to make a recognition of students at an early age. I think that would be very useful.

You commented on the amount of the awards and I think there will have to be some change there because a student could overcoup $5,000 in one year, working in computer science or something of that sort so I see that as no inducement at all.

I was not quite sure about the teacher awards. Are these some sort of mini-Nobel prizes or something so they can just take the money and do what they want to do with it?

Are they designed to further their education in some manner or what? I do not know. This is a question.

Senator DOMENICI. Actually, they are permitted to do what they want with it. The thrust is that we hope they further their education.

Dr. VANCE. I see.

Senator DOMENICI. We hope they do something in enhancing their own excitement about the field.

Dr. VANCE. OK. I think that is an interesting idea. I think, of course, at the college level we have sabbaticals where you can take a year off and go and study and they are very useful in terms of renewing your interest and learning different things and so, in that light, it may be that you want to look at the amounts a little bit more carefully.

Senator DOMENICI. Sure.

Dr. VANCE. Let us see. Well, people said most of the things that I wanted to say, also.

The State Commission on Excellence. I want to make some comment there. It seemed to me that this might be a major component of the bill and of course I would be concerned about how they are selected and who constitutes these commissions.

FILTERING DOWN OF MONEY SHOULD BE LOOKED AT

But in the light of block grants with money sort of filtering down based on a head count, I have great concerns about what happens to dollars when they come that way. As I look at some of the title I's and chapter I's and whatever they are calling it now, there is money that has come to local units and there was no planning in what was to be done with the money. There was no careful look at a way of spending the money and so you find closets full of old materials in various places and people do not know what to do with it,

do not intend to do anything with it, cannot do anything with it but they, indeed, had to spend the money because it came to them. So I have some concerns about that in terms of block grants.

It seems to me, at the State level, we need to have some kind of assistance, someone who decides whether or not the money goes on and I think my two colleagues earlier said things that hit at the same idea.

The National Science Foundation has people who are trained, who look at programs and make decisions about whether they are good programs and whether to award the money or not.

I am not concerned about whether the NSF does it or somebody else does it as long as there is some careful thought given to whether you get the money or not based on whether or not you have a program in place before it comes out and that there are people at the State level that can handle this.

And I think, in this case, in—well, not in this case but the State commissions may have to play a larger role in making some of these determinations.

I think, also, that, along these lines that it is important that there is some agency that takes a careful look at the proposed projects before the money's awarded because we have had lots of programs in the past that were very slick programs that did not do much of anything to help the teachers who were involved, and I am talking now primarily about in-service programs that were operated by colleges and universities.

Because the universities have people who do nothing but write proposals to get money and I am reminded of a fellow that I knew in another State who passed out cards saying he was a million-dollar professor, which meant that he had gotten a million dollars in awards from the National Science Foundation and the Office of Education.

PROGRAMS NOT WELL-THOUGHT-OUT

Oftentimes these programs are not well-thought-out and they do not do much to help the teachers who are involved in them. For example, I think that it is very nice that a teacher know how to solve differential equations if he is going to teach in elementary school. I think that is very admirable but if they do not know five ways of explaining the enumeration systems to students, they are not going to be very helpful and there have been programs of that type.

On the other hand, there have been programs that did nothing but try to teach people how to teach without having any mathematics background at all and I think it is nice that we have people who are in the classroom but happy, ignorant people do not help us much at all.

And that is what happens with mathematics in terms of many classrooms. I have visited elementary classrooms. I see teachers who know a lot about how to teach but they are teaching the wrong information. They are not teaching the right things and I think that we have to be careful about where we award the money and what we award it for.

Now, this is not to say that there have not been good programs under title I or under the other programs we have talked about. They are very good programs but I think far too many of them have not addressed the appropriate topics or the appropriate things.

I would ask that we try to have many cooperative ventures among the local school districts, the colleges, the State Department, business, and industry, that we work together in a very comprehensive way to design programs for children at all levels and for the training of teachers and the retraining of teachers.

I think these are the type of programs that will give us more benefit than anything else.

Well, let me make a couple of comments about things that I heard earlier. That is one of the advantages of going late. You can attack people who will not get a chance to get back at you.

MUST HAVE TEACHERS THAT KNOW SUBJECT

There have been some comments about mathematicians and scientists and people who are educators and I do not see the two as being mutually exclusive and I think I wanted to say that because it seemed to be skewed too much the other way.

I have had classes from many good mathematicians who were excellent teachers and also from mathematicians who were not good teachers in my way of thinking, but at least they knew enough about the subject to be enthusiastic about it. In many cases I think they were better for me because they certainly got me out to the library in a hurry to do some reading and to learn about the library.

So I think we have to have people in our classrooms who know enough about mathematics to recognize good ideas when they hear them. Oftentimes in the elementary school, the student comes up with a clever way of doing something and they are turned off because the teacher does not understand, really does not understand that it is good mathematics.

I wanted to make that comment.

Also, I want to make a comment about your question on public broadcasts.

Senator DOMENICI. Yes.

CAN'T TEACH MATH VIA TV

Dr. VANCE. I worked for 2 years on a program that was designed to develop television shows to teach mathematics to students in the fourth, fifth, and sixth grades and my conclusion is that we do not know how to do it via television. We did not learn how to do it there.

Primarily, television has to be entertaining before it can be anything else and the entertainment prevailed in almost every case. Our shows did not teach very much mathematics.

But I really am optimistic that it can be done. We just do not know how to do it. And I think the same thing would apply to public broadcasting.

I think you can teach students or anybody to throw a piece of paper into the trash can because it is a simple kind of thing. If you drum something at them, they can remember that.

I think maybe we have been set back 50 years in this conquest by Sesame Street because of the Madison Avenue type approach that it uses. It is just the first stage of education and that is where we are.

I would hope that we would continue to look at ways of research and how we go about doing broadcasts on radio or television and that it is taught because I do think there is great potential there. But I do not think we know how to do it at all at this point.

Thank you.

Senator DOMENICI. Thank you very much.

Dr. Mehaffey.

STATEMENT OF DR. GEORGE MEHAFFEY, PROFESSOR, SCHOOL OF EDUCATION, EASTERN NEW MEXICO UNIVERSITY

Dr. MEHAFFEY. Thank you, Senator.

I think everyone who has testified before us certainly demonstrated the shortage of math and science teachers and the need for more. The problems are obviously multifaceted.

Some solutions are easy. Strengthening requirements for math and science teachers we have done. Other State institutions have done it. Providing scholarships and the like, those are also easy.

OBSTACLES TO IMPROVING PROBLEM

Some solutions are, frankly, unattainable. Math and science majors will not go into teaching as long as they can make twice as much in industry. Talented women will continue to exit teaching for heretofore closed occupations. And in general, talented people of all kinds will not go into teaching as long as the perception is that teaching is an inferior position.

In a word, education will not be truly valuable until it is valued.

Despite the good intentions of this particular bill, and I applaud some of the efforts, the legislative efforts to provide more math and science teachers, I suspect, are doomed to failure. What it appears to me that we are doing is that we are repeating the 1950's and 1960's. We are going back and we are going to pump millions of dollars into science and math education.

That effort is inevitably deluded. Recent studies report that there are only small remnants left, vestigial remains of what was once an enormous national commitment to science and math education, a trained teacher here, almost in retirement now, perhaps, a textbook there. But virtually nothing left of millions and millions and millions of dollars of education.

Indeed, I have a greater concern and that is that the legislation may cause more harm than good by providing a few good teachers and thus widening the gap between the technological haves and have nots while at the same time quieting the clamor for more aid for the shortage we presently enjoy.

Expenditures equivalent to one guided missile frigate will never provide all the math and science teachers we need and if you do emphasize that kind of funding, you will not resolve the problem.

BROAD DISSEMINATION OF INFO NEEDED

The failure is that we have not redesigned, conceptualized or thought seriously about the delivery system that we employ.

The problem is particularly acute for small schools and rural schools, the kind of schools that Eastern New Mexico University represents and the kind of schools that the State of New Mexico largely represents.

Small schools are not so much isolated geographically as they are isolated intellectually from ideas, information and particularly from access to information. In a sense, what we suffer is a common disease, hardening of the categories.

John Naisbitt, in his recent book, "Megatrends," talks about the way that conceptions of what we are guide, inform and direct the choices we make. Naisbitt specifically talked about companies. The example that he used was railroad companies. He conceptualized that their role was the role of being in the business of running railroads.

When technological advances made railroads impractical, they continued to make choices based upon that limited, narrow perception while other companies, seeking to ask the same question, "What business are we in?" chose the broader view and thus made those kinds of choices.

I will give you a specific illustration here. Your staff determined to make or to have a hearing of the Senate Budget Committee in Las Cruces. That decision, that conception animated the choices that you subsequently made. You then needed hotel rooms. You needed travel to Las Cruces. You needed all of us to come to Las Cruces.

I drove 6 hours for that and a number of others drove equal distances.

If, instead, you had conceptualized that your task was to hold a statewide conference on the needs for math and science education, then you would have discovered that the three public broadcast stations in this State all have two-way communication with one another.

You could have been in Albuquerque. I could have been in Portales. Dr. Byrne could have been in Las Cruces. We could have gathered in those places and conducted this conference.

We chose not to do that, primarily because we did not conceptualize our task that way.

Senator DOMENICI. No, we really did not. But we did not do it for that reason. We did it because the U.S. Senate has not arrived at the point in time when it conducts formal Senate hearings any way other than to have witnesses appear in person and to have somebody take all the testimony and put it into a form that can be available permanently to staff and members.

So I am not disagreeing with you, but——

Dr. MEHAFFEY. Well, Senator, in the courtroom for example, we have now allowed videotaped testimony. Well, what I was proposing is live testimony simultaneously at the three channels and the opportunity to talk back and forth.

THE RESULT OF THE MISSION SHOULD BE FOR THE WHOLE

The question then becomes for us in education. What business are we in? If we are in the business of teaching, what is our conception? Then we clearly need teachers.

But if, instead, we are in the business of helping students acquire and evaluate information, then we need to seek ways to provide information to all, not just a few.

Certainly we still need teachers, for their role will never be diminished. But we need more than teachers. We need networks of information that students have access to.

At Eastern New Mexico University, we are involved in two kinds of projects that we hope will try to deal with this. The first is the computer consortium that we formed in December of this year, this past year. In that consortium, we have invited the 21 school districts that we serve to purchase Minnesota educational computer corsortium hardware to come to our microcomputer labs and to share information.

We hope that that network will grow but frankly, with the constraints on both Federal and State spending, we doubt that it will. That would be the first network concept. It only requires that each school district have a computer, which they all have, a telephone and a modem. We then put information out to them on a message board.

The interesting thing about that network is that that network is not used disseminating to them in a hierarchical arrangement. It is that they, too, can put information on that message board. We thus can all share the information.

I recently talked about a second tier of networking at the State level between the various universities and the school districts that they serve.

A third tier of networking is possible between the States and some national entities.

PUBLIC BROADCASTING

A second kind of networking that Dr. Vance and others have alluded to is the better utilization of public broadcasts. Next fall we hope to do a computer literacy course; 3:30 in the afternoon, in the middle of the week, during the year, for teachers as an in-service program with credit.

One of the attributes that we hope will change the normal, rather dismal history of public broadcasting in terms of its effectiveness for teachers is that we also hope to include in that program onsite visits and human interaction.

It seems to me, one of the problems of public broadcasting in the past is that it has attempted to supplant other relationships and other existing organizations. Thus, we are trying to plan two kinds of networking efforts that, hopefully, will address the needs of education in this country with the existing technology, employing existing structures to tie together schools and universities in a nonhierarchical way.

It seems to me ludicrous that we propose that someone from Sandia Labs go teach in the public schools. If they do, are they

coming to Elida? Will they stop in Durham? Will they come to Grady? I do not think so.

How do we reach children in rural, isolated areas?

The existing technology is there.

Thus I would urge that when this legislation is written, considered, and finally passed, that it takes into consideration these technological possibilities that indeed exist right now and that furthermore, that the legislation consider the rather large question and the important question, it seems to me, What business are the schools in?

Senator DOMENICI. Thank you very much, Doctor.

ASSESSMENT OF PAST HISTORY

Let me suggest that I am most appreciative of your remarks and I do think you are right on in terms of some major breakthroughs and major concepts that have to be implemented.

However, I disagree significantly with your assessment of past history and also the next few years.

I think the main failure with the heavy funding that occurred immediately post-Sputnik is not that it has been a total failure, as you describe it, but that we did not find a way to continue its effectiveness.

As a matter of fact, I think the facts are dramatic that it was extremely successful. But it was too short-lived. In fact, it did produce a huge number of people that were interested in science, obtained an education in science and all the related fields, and gave us a short-lived answer to what was a growing problem.

We are hopeful that, as we proceed with this, we can understand better that the program must have some continuing effect. We do not think that is a 50-year Federal program. We think it is a Federal program that addresses the shortcomings that we have at the local level and encourages maximum utilization of everything available, The Federal Government will be catalyst.

I think that is where we failed in the Sputnik era, but I do believe the present generation of scientists probably owe a large percent of their success to that post-Sputnik era that you have described as a failure. I think it has some real lessons and in Albuquerque some people assessed it quite differently from you by saying it was a huge success, but the problem is, we did not, at the State and local level, build in something to continue it and we were not innovative enough to move into the next generation of pedagogical skills.

COUNTRY FACING REAL EDUCATION PROBLEMS

But at this point, let me suggest to you that there is, right now and for the foreseeable future, two very distinct human problems:

Not enough young people choosing to enter the field of science and math teaching and not enough classroom teachers expert in it that want to teach those subjects.

Now, granted, there are going to be all kinds of innovative ways to teach and much advanced technology we ought to be using but I do not think, for the foreseeable future that we can ignore those

two realities. We were not really trying to find a solution to all the problems of education in designing this bill.

Basically, we were trying to address those two main issues and then provide some seed money for a new concept: excellence in math and science. And that accounts for some money going to the State Commission on Excellence in those areas and some seed money to the States with great latitude and flexibility for them to do, on their own, whatever they see fit to move toward excellence.

And we purposely intended to make that only guidelines; very flexible. We still have to assess whether dispersing it that much, which you raised, is as good as focusing more in certain areas and letting others borrow it. But basically, I am sorry that you think it may do more harm than good.

I can tell you unequivocally that I disagree with you and yet I greatly appreciate your expertise and your thoughts.

Dr. MEHAFFEY. I did not mean to imply that they were a failure, that the science projects were failures in the 1950's and 1960's. It is only that we now face the problem again, as you point out. It is the continuation of that.

EDUCATION MOMENTUM LOST BECAUSE OF SYSTEM

Senator DOMENICI. Yes. Well, that is democracy for you. If we could rule by fiat, we probably would have seen all the good things coming from it and if we had somebody benevolent at the top end that could have ordered its continuation, it might have worked but it is just very difficult to continue those kinds of things.

We will try very hard as a result of what we have learned to build permanency into it. But I do not think that permanency is going to as a matter of course. I think it is going to come with something else, some kind of an attitude that we build up and a State and local commitment that we build up, not some litany of Federal mandates.

Did any of you have any further comments?

I greatly appreciate your testimony.

[The panel of witnesses is excused.]

Senator DOMENICI. Mr. Bill Floyd, superintendent, Las Cruces; Dr. Delbert Dyche, elementary curriculum director, Las Cruces; Mr. Jim Miller, Superintendent, Carrizozo; Jim, you have a counterpart with exactly the same name who is superintendent in Santa Fe, so we have had two Jim Millers testify.

And Don Woods, Superintendent from Hobbs.

We are very delighted to have you.

Mr. Floyd, perhaps you could lead off.

STATEMENT OF BILL FLOYD, SUPERINTENDENT OF SCHOOLS, LAS CRUCES, N. MEX.

Mr. FLOYD. I thank you for giving me the opportunity to come and express some views from the superintendency, Senator. I would like to preface that I have put a little over 23 or 24 years in the public schools, 12 as a teacher and about 11 as a high school administrator. I have been in the superintendency less than 1 year, so many of my views may come more from the classroom and the school than from the central office.

I would like to begin by applauding your effort at the national level in bringing to the light a need for public education, be it science or math.

I have been reading very recently of efforts in terms of tuition tax credits and those kinds of things that have some impact on the public schools but again, I complement you in addressing a situation that I think we will appreciate in the long term as far as it is going to help some kids get through public schools.

I want to say that as far as your bill is concerned, I think it is excellent. I think it is a good starting point and I think we have a long way to go beyond this and just listening to you today, I think your feelings are the same as mine. This is a kind of a beginning and we are going to just keep on going and hopefully go beyond the areas of science and math.

TEACHERS NOT CAUSE OF DECLINE IN EDUCATION

We have had some evidence of decline in the public schools in regard to the well-known SAT scores. Many of our high school graduates have been taking little, if any, science and math courses. There are not enough science and math teachers available and many of these declines have been blamed upon our education or classroom teachers and I would like to disagree with that.

Many times we are blamed for the inadequacies that are going on and the inadequacies of some of our graduates. I think there are a lot of things that come into play that are not necessarily blamed at the classroom level.

There are some statistics available but I think we have heard enough today so I think I am going to skip through some of this material that is redundant. I would like to touch on one aspect that you mentioned earlier in the opening, Senator, on the comparison between European and Japanese education.

DO NOT REQUIRE MORE TIME ON TASKS FOR STUDENTS

The one point I would want to raise is, I do not think the kids are that much different. I think they are putting more time on task and I think that is one area that we can approach, the time on task, a longer school day, a longer school week, a longer school year, whatever it takes to have more instruction going on in the classroom.

I do not believe in the fad, if that is the case right now, of increasing requirements for graduation. I am a firm believer in adding to present requirements for graduation in the State of New Mexico. I do not believe you can pile on credit after credit on students who are already blamed as not being able to handle this kind of material and then add additional requirements of a difficult content area.

So what I am saying is, I think we need to ease into this situation and I do not think we can even ease into it in high school or even at the junior high level.

I agree with many of the people that testified today that we have got to do something about math and science education, probably beginning as early as kindergarten or first grade.

And I think, again, it rests with our teachers and the things that we can do to assist teachers in that endeavor.

WHY SCIENCE AND MATH TURN STUDENTS OFF

I have some feelings regarding why science and math may not be perceived well in the eyes and minds of young kids. When we see much of our national news on the nuclear generation plants; the nuclear proliferation; these kinds of accidents that are occurring; the inflationary costs of equipment nationwide on all kinds of items; our environmental education seems to be taking a back seat to what we have been doing with clean air and so on and so forth. The advent of the use of calculators and computers is making things a little bit easier in terms of what we are supposed to be learning and how we apply what we have learned. We are learning shortcuts that, you know, have short-range implications on achieving some objectives.

But in the long range, we may not be acquiring the necessary content and process of courses that help in thinking, in making decisions and those kind of areas.

SALARY INCREASES FOR SOME TEACHERS

Addressing teachers, I would be in disfavor of additional moneys or salaries for a segment of the teaching population such as math or science teachers. I believe all teachers should share equally in whatever benefits are available because it takes all kinds of education to make a total kid. Teacher salaries are——

Senator DOMENICI. Excuse me, do they have any difference?

Mr. FLOYD. No, sir; not at the present time.

Senator DOMENICI. There is nothing that you are aware of that the State is contemplating a differential?

Mr. FLOYD. No, sir. In our economic crunch, Senator, we are having difficulty making ends meet as it is.

We see many, many ways that perhaps, as was mentioned earlier on, on the public broadcasting or even commercial broadcasting, there are lots of neat kinds of things available. We could begin to compliment and show some positive attitudes toward education that might not add to so much burnout, not add to so many kinds of criticism in regard to the teaching and the learning taking place in the public schools. Although you cannot put that in your pocket and take it to the grocery store, you can certainly raise your head a little bit higher when you go in and say, "You know, I have got a product here that I have been working on for years and years and years and I have accomplished something.

"It may not be something as tangible as a computer or a loaf of bread or something that is grown and baked, but it is a tangible product that is having some kind of impact at the national and State levels."

PARENTS NEED TO HELP EDUCATORS

We need to work very closely with parents. I have always believed that teaching and learning is hard work. We must be able to

convince our critics and parents that we are going to give the kid the best education we can.

That kid is going to have to participate in that endeavor.

The parents need to try to continue to encourage kids to do a little bit more than is necessary, not just to meet minimums, during what little time we have with that kid in the classroom.

I raised some questions, and I am not going to go over my time. We raised some questions and I would ask this:

We have students who choose more than 4 years of music. We have students that choose more than 4 years of art; 3 and 4 years of home economics, 4 years of physical education; 3 and 4 years of typing; 3 and 4 years of vocational program.

Why do not kids choose 3 and 4 years of math and science? Something happens as the kid matures, as choices are made, and begins to choose one curriculum over another. I think we need to start asking those kinds of questions and looking for those kinds of answers.

Regarding, you know, the outcry now as far as math and science is concerned, in the time that I have spent in public schools, you have had an outcry of, Why can't Johnny read?

We have taught Johnny to read better. Why can't Johnny write? Why can't Johnny do civics better?

What about drug abuse? What about career education? What about physical fitness? All these things that have come at the national level and filtered down to the State level, there has always been a national need. We need to address these things.

PRIORITIES MUST BE ESTABLISHED

The same thing you mentioned earlier about the Sputnik. We address those things. But every time a new item comes in to address, it stays in that curriculum and we get some more diversification from the content area that we are addressing now.

We need to start making some priorities in the public schools as to what is necessary for most of us.

In conclusion, you alluded to the James Kilpatrick editorial, Senator. One of the quotes from Admiral Rickover, that I reread when you mentioned it earlier, says, "Admiral Rickover who, I think, considers himself a scientist and perhaps an engineer but I think he is also an educator," he says, "Give me a high school graduate with a well-rounded education," he said, "And the rest will come later."

I think we might listen to the admiral again.

Thank you.

Senator DOMENICI. You ought to see how selective he is. [Laughter.]

I think we would all agree with his screening process. What drops through his screen could succeed at anything.

Dr. Irvine asked a question about graduates, whether a graduate student who did not have the basic science could use the funding?

Now, I just checked and it does. We would surely not intend to limit that. In other words, we are not trying to say, "You have got to get started as a freshman in this." It is at any point in time, in the legislation the way it is drawn.

Let us proceed.

STATEMENT OF DR. DELBERT DYCHE, ELEMENTARY CURRICULUM DIRECTOR, LAS CRUCES PUBLIC SCHOOLS

Dr. DYCHE. Senator, thank you very much for this opportunity. I think I would like to start by sharing some good news, some signs of progress that I see occurring here in Las Cruces.

LAS CRUCES STUDENTS EXCEED NATION IN TEST SCORES

Last spring we tested all of our fifth graders using the new edition of the comprehensive test of basic skills and the median score for this group of 1,000-plus students was at the 66th percentile in math computation. That is 16 points above the median for the national sample of 163,000 students.

Also, these students had a better understanding of math and were able to apply their math skills better than their counterparts around the country. Their percentile ranking on that subtest was 54.

Our total math score was at the 60th percentile.

This is a marked improvement over the scores that we studied through the early 1970's. During the new math era, all of our computation scores dropped rather dramatically.

Our median science score for this group of fifth graders was at the 52d percentile. These fifth graders did extremely well for us and they are a source of pride for our teachers and this community.

I think one thing that has emerged in my study of science curriculum in this district is that many elementary teachers tend to be far more comfortable teaching natural science than physical science.

Our written curriculum, which was developed by teachers, displays this bias.

SCIENCE MADE PRIORITY AT TEACHER CENTER

As we revise curriculum in the future, it is my intent to see that a better balance is created. I would suspect that this lack of balance is not unique to Las Cruces.

We are fortunate in having a teacher center here that is able to offer staff in-service support in any curriculum area and this year we have made science a priority. Our assessment of teachers needs gave us some good planning information that might be of use to other districts attempting curriculum improvement in this vital area.

Some of our findings in surveying teachers were that there is no consistency in the amount of time being spent teaching science from classroom to classroom. It may vary from 30 minutes a week to 30 minutes or more a day, within this district.

The State of Iowa has gone back to prescribed amounts of time for each discipline. New Mexico got away from that a few years back.

Also, teachers see fellow teachers as their first source of help as they look for ideas, information, or materials relevant to science in-

struction. The majority of teachers responding to our survey want materials lists for their units.

To me, this indicates that they are willing to use nontextbook approaches and really get kids into process approaches in teaching science.

In-service workshops in science were requested by 125 staff members with 93 stating that they would be willing to attend after school or in the evening, which I think is a tremendous commitment.

Senator DOMENICI. Yes.

Dr. DYCHE. The majority favor the designation of a science representative from each grade level who would attend special workshops and share information gleaned with his or her colleagues.

SCIENCE CONSULTANT HIRED

One of our first steps in beginning to meet these needs was to hire Dr. Tom Votaw to serve as a science consultant to the teachers for this school year. He is charged with the responsibility of setting up a science workshop for each grade level. His time with us is very limited because of budget constraints but it is a beginning and I think it is a concept that should be expanded, if funding were available.

Senator DOMENICI. What does he do?

Dr. DYCHE. He is responsible for setting up a science workshop for each grade level. He is setting up some Saturday programs for kids. And he is working directly with teachers in the buildings.

Senator DOMENICI. But he is part of the school system?

Dr. DYCHE. He is hired on a contractual basis for so many hours of employment. We would like to be able to have more time but just cannot afford it at right now.

I think students are either turned on or turned off to science and math while in the elementary schools. The test results and teacher attitudes indicate to me that we are making progress here.

When I think of all the merry and not-so-merry chases that we have led our teachers upon since Sputnik was first seen in the night sky, I am amazed that elementary curriculum is so stable and so result-oriented. My concern there is the lack of continuity, the fact that we will make science a thrust for awhile, then math becomes the focus, then bilingual education or whatever, all very noble programs. But instead of keeping the good things going, we throw the baby out with the bath and seem to start out all over.

Senator DOMENICI. Much like Bill said.

Dr. DYCHE. Right.

Senator DOMENICI. You either do that or we keep adding on.

Dr. DYCHE. Right. I think the quote that "those who fail to learn the lessons of history are doomed to repeat it" keeps me ever-mindful of our obligation to avoid some of the tangents of the past and to seek a balanced curriculum of substance and not froth.

In our quest for improved math and science programs, we cannot forget the importance of the humanities.

MODELING CAN BE MORE EFFECTIVE THAN TELLING

I think there are some fairly inexpensive ideas that come to mind to strengthen our math and science programs in elementary schools and subsequently, to help elementary students become motivated to take these programs as they move into junior high and high school. Since teachers look upon colleagues as the first choice for help, if we could buy substitutes, get some release time for outstanding math and science teachers in an elementary school to assist their colleagues with classes and planning, I think much would be gained.

Modeling can be far more effective than telling.

I think if we could free some of our science and math teachers at the secondary level and then some of their students to visit elementary schools, it would help with the recruitment of those students as they move into the secondary programs.

I think whiz-bang experiments and students and teachers sharing their love for their subject could make a profound impression upon elementary students.

I think we need to improve our lab facilities at the junior high schools. I admit that we have too much textbook orientation to science at the elementaries. It becomes a source of boredom as those kids move into the junior high to see those same types of approaches and some of the same material duplicated that they covered throughout their elementary program.

I think this would encourage elementary students to look to science electives when they arrive at junior high.

I would like to see us providing increments for teachers who are interested in sponsoring after-hours math, computer and science clubs, Saturday morning seminars, calculation contests and science fairs. I think these would also increase student knowledge and skill.

I think these are just a few ideas and we could sit here and brainstorm and come up with many more that are not too expensive and will be highly motivational to students.

Science and math skills must be developed in all children.

The National Math and Science Excellence in Education Act I think will strengthen and support our efforts in these critical curriculum areas.

Senator DOMENICI. Let me tell you, as you talk about the kinds of things that could be done locally, I am reminded that the ultimate and continuing success in these areas is going to be because of people like you and districts like this that try to assess the problem and get on with the best available solution.

ADD TO AND AMPLIFY LOCAL INITIATIVE

You know, when we had the famous Heinz ketchup situation with reference to school lunches, I think the Secretary of Agriculture's assistant was accused of wanting to minimize what was on each child's plate and counting ketchup as a vegetable.

The national government got all concerned. A bill was introduced in Congress, apparently by somebody who prepared school lunches, that said, "On Monday, every school that uses Federal

money, the plate will have the following on it. On Tuesday, the following. On Wednesday, the following."

Well, thank God it did not get anywhere beyond introduction. But the solution to the problem in Albuquerque came when some interested parents got together with an interested principal, who got together with an interested nutritionist who was preparing 80 percent of the lunches through a collective system in a large school system. They sat down and talked about it and they came up with their own solution that was very, very flexible, different, saved a whole gob of money and created a fantastic program.

I think, your caveat is, at the bare minimum, do not minimize experience and opportunities that we are generating locally, add to them and amplify them.

Dr. DYCHE. Right.

Senator DOMENICI. Jim Miller.

STATEMENT OF DR. JIM MILLER, SUPERINTENDENT OF SCHOOLS, CARRIZOZO, N. MEX.

Mr. MILLER. I would like to talk for a minute about a little different perspective, maybe, on the problem the bill addresses. I have not had a lot of time to read the bill but want to talk a little bit about some of the unique problems that the rural and small schools in New Mexico have in particular.

As your staff has probably made you aware, about 57 or 60 percent of the 89 school districts in New Mexico have less than 1,000 students. Of those 57 or 60 percent, 19 of them are generally referred to in New Mexico as the supersmall schools."

Senator DOMENICI. Right.

Mr. MILLER. They have less than 200 students on a daily basis. This context of size brings some unique problems. I have to smile a little bit at my colleagues here at the table, as well as some of the people who have spoken here earlier, when they talk about having 15 applicants for math teaching jobs in a year. In 4 years in Carrizozo, I have not had 15 total applicants for mathematics.

UNIQUE PROBLEMS OF RURAL SCHOOL DISTRICTS

I want to share with you two very brief stories and then talk about some of the other unique problems.

In 1979, I was looking to fill two mathematics teaching positions and I could find three applicants. One was certified with a math teaching degree. A second applicant had 4 hours of math college coursework and had taught mathematics at a junior college in the Carribbean. Another individual had a year and a half of college, was a local rancher in the Carrizozo area, had 12 hours of math and had taught at the postsecondary vocational level in California.

I called the State department and asked them what I was to do to fill the one position. They finally decided to recommend to go ahead with the local rancher.

For the next 3 years, finally culminating in May of this last year, this gentleman drove 160 miles two nights a week to New Mexico Tech to finally receive a math teaching degree.

I gave him a day of release time every week for several years, plus a $2,000 scholarship from the National School Boards Associ-

ation to simply help defray his travel costs. I think that is a pretty good example of what rural and very frequently isolated schools go through as part of this profound problem.

A second one, which other people have given other examples of and I will just simply add another one to that list, was that in 1980 I did replace a math teacher and had one applicant that year who had a doctorate in metallurgy and, of course, quite an extensive mathematics and science background.

He was familiar with rural areas because of mining activity in central New Mexico. We employed him to teach, to be the high school math department, teaching five separate mathematics courses and paid him, I think, somewhere on the order of $14,800.

He left a year later to go into industry over here at Hillsboro with a mill. He got $32,000 to start over there as an assistant metallurgist, which of course, was more than I or anyone else made in the school district.

That is the kind of competition we are facing, along with everybody else.

Senator DOMENICI. Was the rancher a good teacher?

Mr. MILLER. Excellent.

Senator DOMENICI. Well, you did not tell us that.

RURAL TEACHER'S HAVE NO COUNTERPARTS TO CONVERSE WITH

Mr. MILLER. In doing a little preparation for the comments today, I talked with the two science teachers that I have and the two math teachers, including the rancher.

As they have observed and I would also report to you, one of the problems is that they have hardly any colleagues to talk to.

If they have a mathematical or scientific problem, there is no one to go to who has the academic background to help them resolve the problem. Literally, they are a one-person department and, as well-meaning as other people on the staff and the faculty may be, they do not have any help.

Second, we see the universities and the State departments of education going toward more specialized certification requirements in mathematics and science. At the local level of rural schools we need more general requirements because we have at present a high school science teacher who must teach general science, biology, chemistry and physics and must be endorsed in all those areas.

The same way in mathematics, with consumer math, algebra I, algebra II, advanced algebra and so on.

We also see, as far as simply the encouragement and motivation to continue to teach in rural areas, that students come to us with very limited math and science backgrounds. We do not have the libraries, the museums and so on as the larger communities do. Consequently, students at the elementary midschool and high school level, have very little math and science background.

We also have difficulty in keeping up with what is going on in math and science in the high technology areas and maintaining material and equipment support to keep abreast of those advancements.

As far as some of the things those of us who work in rural schools see as being helpful in solving these problems, I think the

Southwest Center for Science and Engineering has been a great deal of help. We have sent several of our most interested high school students to summer institutes at New Mexico Tech and New Mexico State, plus we have gotten involved over the last two summers with the science and math teacher training.

And I think those efforts should be continued.

ESTABLISH VIDEOTAPE LOAN PROGRAM FOR RURAL SCHOOLS

A second thing that would be very helpful is some type of a loan library of microcomputer discs or video tapes for rural schools that could be sent through the mails or delivered in mobile units since we cannot achieve economies of scale.

That would help us in keeping abreast of this technological development.

UNIVERSITIES SHOULD OFFER OFF-CAMPUS COURSES

The third thing is that colleges and universities should be encouraged to offer teacher training and recertification courses in off-campus remote areas. They do need extra encouragement to do this, and I must say New Mexico State has been most helpful in this area.

When, in our area, for example, we could probably get two to four people together for a class, the universities have to have their economies of scale and are often reluctant to field classes with such few people in them.

There are some alternatives. With the sateilite technology and videotapes and so on, those classes can be prepackaged and sent to rural areas. Those would be very helpful.

Another thing that programs, like the Southwest Center, can provide that we desperately need is field technical assistance people who can come out and advise science and math teachers onsite and do so with some frequency.

As I said, we do not have any collegial support to speak of in a rural area. Certainly, on advanced technical matters, those people are not present and we could certainly use that kind of help.

I would also encourage summer programs for kids. That seems to encourage kids a lot to go to New Mexico State and to Tech and major in science and math. We have had pretty good results there.

MORE STUDENT TEACHERS FOR RURAL AREAS

I think another thing that might be looked at is student teaching. Research is fairly clear in showing that where people do their student teaching, they are likely to seek employment and eventually become employed.

The universities have pulled back in the last few years, due to their own budget problems in having student teachers in rural school districts, with the exception of agriculture and home economics. We, and I think most other isolated rural schools, have very few student teachers any more.

I think that trend needs to be reversed and perhaps with some legislative encouragement. What we find is that if those people will

come and student-teach in a rural district, they will be likely to stay then, as full-time employees.

I think as far as several closing comments, then, on Senate bill 248, I would encourage that adequate weighting be placed in the bill for rural areas. Our fixed costs are much higher and we have some unique problems that a more general bill might not address.

The second thing is, I would encourage you to minimize the paperwork in it. We have been real pleased, I think, in rural districts, with the Education Consolidation and Improvement Act Bill, the Chapter Two portion of which dramatically increased our flexibility at the same time it decreased our paperwork.

Particularly when you are looking at a one-administrator office, as so many of us have, plus the data collection requirements that the teachers invariably assume, a very desirable feature of this bill would be to keep the paperwork down.

I would hope also that you can continue in your hearings to actively and aggressively seek the input of rural educators of all kinds and fashion some rural features in this legislation.

Thank you.

Senator DOMENICI. I certainly appreciate your points. You know, before you got to the student teaching in the rural areas, I was thinking that at the University of New Mexico Medical School, they have an extremely unique program that has received substantial Federal funding that addresses a very simplistic issue but has some connetion here with Jim's testimony.

You know the medical schools in this country take all of the young people and bring them to a medical center where they are educated with every kind of tool and diagnostic aid and every kind of specialist in the world. Then they get their M.D. degree and they probably get their training up the street at the VA hospital with some more superpeers. Then somebody comes to see them and says, "Gee, Joe, why don't you come and open your office in Chama?"

Can you imagine the trauma? They feel very smart and very well educated and they are superequipped. The research indicated that just the idea of no longer being around what they have learned is doctoring is enough for them to say, "No."

What they did, and we do not know the result yet but we are just finishing up 4 or 5 years, was to change the program around so that a portion of that 6 years is spent out somewhere in a rural area, establishing some communication link. They think it is going to result in a significant percentage of young doctors feeling confident enough to move to a rural area.

ASSISTANCE TO UNIVERSITIES TO TRAIN FOR RURAL AREAS

I do not know if there are any lessons in that, but it does seem to me that one thing missing in the bill totally, is in an in-house training for those that are already in the rural areas, where they are going to have a very, very difficult time upgrading themselves. And then, do we offer some assistance to universities to train for rural areas?

And if you could address that later for me, Doctor, in any way that would make some sense, I would really be delighted because I

think there is a real difference and I do not think anybody is addressing it now.

Could you maybe give some thought to that and get it to me in writing?

Dr. BYRNE. Yes.

STUDENT TEACHING SCAREY

Senator DOMENICI. I tell you, it is frightening to take that last year of student teaching in math and science. When I did my student teaching, I thought I knew a lot about chemistry and they sent me over to Albuquerque High School to not only teach but then run a lab in the afternoon. I was justified in my fear because in one of my labs we almost burned Albuquerque High School down.

The young man that did it had a Bunsen burner and he was going to do an experiment. I just was not up to snuff and the stuff he poured on the Bunsen burner had a kindle point so low that it would have burned without the Bunsen burner if he had just exposed it to the air. You can imagine what we had.

So I understand the trepidation among the people you have described when you say, "Well, we are not only hiring you to teach chemistry. We are going to have you teach all these other things."

You have to want to and need a job pretty badly, I would assume.

Mr. WOODS.

STATEMENT OF DON R. WOODS, SUPERINTENDENT OF SCHOOLS, HOBBS, N. MEX.

Mr. WOODS. Senator, I realize that by this time, about everything has been said that can cover this topic. I want to take just a few minutes to tell you how Hobbs is planning on handling the situation of qualified math and science teachers.

LOCAL "LOAN FORGIVENESS" PROGRAM

They feel that this is a shared responsibility of the national, State, and local level. On the local part, presently, they are considering a program where they would budget about $25,000 to $30,000 a year and provide scholarships for about eight existing math and science teachers that are onboard.

Now, we think they are good teachers but we hope to make them better teachers. They would be sent to summer programs. It would be very structured and it would go through the committee locally on what they should take.

They, too, if they participate in this, would have to agree to spend at least 2 years with the system after that, because the board of education feels that basically, to solve this at our level, we are going to have to hire the best that we can and then provide them with additional training.

Now, this is not an answer to everybody. This is the way they are thinking and facing it.

Senator DOMENICI. Sure.

Mr. WOODS. I would like to say, though, sometimes the Hobbs District is viewed as the district of milk and honey as far as the

finances are concerned and it might be said that it is easy for them to do this.

But I would like to quote one statistic out of the Public Finance Statistical Manual for 1981-82, "84 school districts expended higher costs per student than Hobbs, 4 districts less."

I bring that out simply to show that we are setting this as a priority and that it is our top priority.

I think you are probably aware that the president of the Hobbs Board of Education has been on the phone with your staff on several instances discussing this very problem. They are concerned about it. But I think the main thing that Dr. Kernan wanted me to express to you is that we fully support your program and he wanted you to know that we feel that there is a local responsibility which we plan on addressing.

Closing, and I realize it is late, I want to make one statement that is a little bit personal. I have been living in New Mexico all my life, 34 years in public schools, and I did want to comment that I have received most of my practical training from a colleague of mine for 18 years, Harry Wugalter, who was chief of public school finance, who is now with Rockwell. He is in the audience today and I am delighted.

Thank you, Senator.

Senator DOMENICI. Thank you.

Thank you very much.

Well, we are on time, so that is exceptional. Maybe we will take a couple more minutes.

Senator DOMENICI. I think we have received some excellent ideas and I am most appreciative.

Maybe we should ask if there are a couple of comments or questions from anybody here that I did not get to hear from?

Does anybody have any questions or any suggestions?

Yes, sir.

Mr. OLGUIN. Senator, I am Eduardo Olguin. I teach in Las Cruces public schools and I am quite excited to see measures such as yours, the one in the House, and the American Defense Education Act being proposed. But my excitement is somewhat dimmed to see some of the areas proposed as far as cuts.

PROPOSED BUDGET CUTS REGRETTED

I see the need for math and science not only at a level of turning out scientists and mathematicians but also technicians who can work in those areas. The $323 million reduction that is proposed in vocational education, the $80 million in libraries, these are areas that are very essential to supplement the program that you are trying to help out.

Another one, I think for New Mexicans especially, my personal bias certainly is behind this one, is the cut in bilingual education. We have talked about the technological advances that we have to compete with from Japan and other countries but I am not so sure that it is just technological advances. Maybe they are better sales people because they come, selling their products, learning our language, bilingually being able to compete where we are sending

salespeople across the world who do not have that type of expertise.

These are areas that as far as a bilingual teacher here in Las Cruces, affect me in the classroom and I think affect people in New Mexico.

Senator DOMENICI. Well, let me make sure that there is not any misunderstanding about your statement. You are absolutely right in terms of the President's budget. That is not intended by you, I am sure, to imply that that is what Congress is going to do.

Mr. OLGUIN. No, I realize these are the things that have been cut from the President's budget.

VOCATIONAL EDUCATION CUT INCONSISTENT

Senator DOMENICI. There is a really an inconsistency in the vocational education cut. I have tried to find out the rationale and the best I can determine is that in terms of the Nation, the percentage of vocational education money that is coming from the Federal Government is very small and, according to the Office of Management and Budget, does not have a major bearing.

Vocational education is funded by so many more sources than the Federal Government at the local level. To me, that is very inconsistent when, on one hand, we recognize a vocational deficiency nationwide. They are about to fund a brand-new Jobs Partnership Training Act that will have a few billion in it which recognizes the fact that there are a lot of people that have to be retrained and a lot of longterm unemployed that need educating; and that whole program is set up over on the side and only coincidentally is related to the school system.

Now, we did succeed with some of my ideas and some good work by Joe Trujillo, who is over here, in putting in the Jobs Partnership Act of 1983 a third title that is going to get funded for the first time on training those who obviously are going to need relocation. That will be funded.

But we did get into the main bill a very strong emphasis that the State board that will run that and the local comissions that advise it will do everything they can to tie an educational institution into providing the service.

I would have basically turned the program over to vocational education. But for some reason, with all the powerful work that educators do, we just never succeed, when we have a national jobs training program, in getting it into the school systems.

If you recall, when we had CETA, both as to its job training and its public service jobs, it was almost marvelous by defining it, what it did not do.

Ultimately we put some amendments in and the public service-type jobs became available to school systems. However, when we started it, we assumed the cities would do all the hiring and placing. At that same point during the last recession, we did not give schools any public service jobs except right at the tail end. While I was a minority Senator, I did succeed in getting some language in with some help from a few people that said, "At least you ought to proportion out some of that to school districts which are as broke as the cities."

DON'T THINK VOCATIONAL EDUCATION ON BILINGUAL WILL BE CUT

But I do not think that vocational education will be cut. I do not think that bilingual education will be cut, although it is constantly under attack by both Democrats and Republicans. I do not want you to think that the OMB Director has the only lock on trying to reduce it. There are plenty of Members of the U.S. House that fight about it and there is a whopping bunch of Senators that will argue about it.

But I do not think those programs will be cut.

EDUCATORS SHOULD LOOK AT JOB PARTNERSHIP TRAINING ACT

I would think it would be far more important for educators to begin looking at the Job Partnership Training Act, lobbying the Governor and the Advisory Council that he must appoint, and looking at the section that allows much of that to be funneled through existing educational institutions, such as public schools and public vocational schools and TVI's and post-secondary vocational schools.

You know, it would be a disaster if we spend $3 or $4 billion on this new program and subsequently we went into communities and found that the new program was like CETA. Under that program people rented their own building and hired a whole group of new teachers, immune from any certification process which you still have to go through forever.

Now, this is not intended to say that CETA was a failure. But this is intended to say that we ought to build on existing institutions for training for these reasons; continuity, utilization of resources, enhancement of the opportunities at the existing schools to capitalize on those resources by being able to be more diversified; helping our colleges of education by getting them involved in these activities.

I think that program may be fully funded, so it is going to be a lot of money, $3.9 billion.

And title III, which is for relocation-type job training is at close to $300 million in that new bill and vocational is cut $300 million. About $250 million is recommended for title III of that new Partnership Act. It seems to me there is some room for merging these two together and getting some maximum benefit out of it.

Is there anything else? Vodene?

DIFFERENTIAL PAY FOR TEACHERS SUPPORTED

Ms. PATTERSON. Senator, I just wanted to add that the State Department of Education had testified in the legislature this year supporting differential pay for math and science teachers. I believe we heard differently at this hearing today.

Senator DOMENICI. Yes, that was stated here but you are telling me that at the State level, there is some movement in that direction?

Ms. PATTERSON. Yes, at the State level and the State Department of Education level there is support for that concept.

Senator DOMENICI. OK and I understand there is no use for us to enter into a dialog on that now or we might very well spend the afternoon at it.

Ms. PATTERSON. Yes.

Senator DOMENICI. If there is nothing else, we stand adjourned.

[Whereupon, at 12:45 o'clock p.m., the hearing is adjourned.]

[The following information was subsequently submitted for the record:]

HOBBS MUNICIPAL SCHOOLS
1515 East Sanger / P. O. Box 1040
Hobbs, New Mexico 88240 / Phone (505) 393-9183

February 1, 1983

Senator Pete V. Domenici
Chairman, Committee on the Budget
United States Senate
Washington, D. C. 20510

Dear Senator Domenici:

The Hobbs Board of Education recognizes the serious shortage of qualified math and science teachers. Your efforts to alleviate this situation are appreciated by Hobbs Municipal Schools.

Recommendations of the Board relating to this problem are as follows:

1. Provide additional in-service training for qualified math and science teachers presently employed by Hobbs Municipal Schools.
2. Permit leave of absence for qualified math and science teachers to acquire additional training on a summer or full year basis. Funding would be provided selected teachers to make the leave of absence attractive enough for individuals to participate.
3. Hobbs Municipal Schools is opposed to extra salary increment for science and math teachers. We prefer funding be made available to provide additional training and in-service for science and math teachers.
4. Hobbs Municipal Schools would expect a teacher to return to the system for a minimum of two years if granted a leave of absence under this program.
5. Hobbs Municipal Schools hopes to provide funds to expand any seed money received if this legislation becomes law.
6. Additional training for science and math teachers would be recognized on salary schedule.

Hobbs Municipal Schools will have a representative present at the field hearing in Las Cruces on February 11, 1983.

Sincerely,

Jack Kernan, M.D.

Jack Kernan, M.D., President
Hobbs Board of Education

JK:clc

MOUNTAINAIR PUBLIC SCHOOLS
OFFICE OF THE SUPERINTENDENT
P.O. BOX 456 / TEL.: [505] 847-2333
MOUNTAINAIR, NEW MEXICO 87036

February 1, 1983

Senator Pete Domenici
500 Gold S.W. Rm. 10013
Albuquerque, New Mexico 87102

Dear Senator Domenici,

Your letter of January 24, 1983, has been carefully reviewed by me, our two principals, and our NM/NEA teacher representatives.

The shortage of qualified teachers, in the areas of math and science, is far greater than your letter seems to indicate. Unless immediate assistance is provided, quality programs in either math or science are in danger of becoming non-existent. The reasons are quite clear. The two main reasons are: Good math/science teachers are underpaid, overworked and largely unappreciated.

Students cannot get excited and stay motivated in environments in which they are expected to study much harder than other students, and without any additional support and/or reward.

I feel that your legislation will go farther, if it is more specific and more directive than you have described. Under your first point, these three items may be done without any Federal Assistance. Under your second point, I wish to offer three very specific plans for your consideration.

First, earmark funds that will be used to allow each district to provide each full-time math or science teacher with a ten-month contract. This move will do much to show that this discipline is worthy of higher salaries, but it will do little or no harm to other teachers who remain on a nine-month contract.

Second, provide 2-4 week Summer Institutes for full-time teachers of math and/or science. The grant they would receive would pay all related expenses and allow them to earn a modest fee in addition.

Third, set up math and/or Science Institutes for students in the same fashion as mentioned above.

Fourth, use national media to help to re-establish the work ethic value as it relates to school subjects in math/science.

I hope to attend the field hearing in Abluquerque, on Monday, February 7, 1983. If possible, I would appreciate the opportunity to provide testimony before your Senate Budget Committee.

Sincerely
Mel Root
Mel Root, Superintendent

AMERICAN INDIAN SCHOLARSHIPS, INC.
SERVING AMERICAN INDIAN GRADUATE STUDENTS NATIONWIDE
P.O. BOX 1106
TAOS, NEW MEXICO 87571

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Miss Indian America XV

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Santa Clara/Navajo
Counselor

Written TESTIMONY BEFORE SENATOR PETE V. DOMINICI
AND SENATE BUDGET COMMITTEE
Albuquerque, NM
February 7, 1983

My name is John C. Rainer. I direct American Indian Scholarships, Inc. This organization is national in scope and is registered as a non-profit corporation in the State of New Mexico.

Senator Dominici and Committee Members, it is a pleasure for me to appear before this committee in light of your announcement of the field hearings in Albuquerque and Las Cruces on the matter of science and math in the elementary and secondary schools of New Mexico.

As an educator, I applaud your efforts to explore positive steps toward promoting higher quality education for our young citizens in these two crucial areas by introducing legislation which will encourage young people to enter these vitally important fields and also rewarding those teachers for excellence in teaching in these fields. I am also pleased to read of your call for in-service training for teachers and, perhaps most importantly, your call for the direction of new money to the states and local school districts to take major strides toward producing men and women citizens skilled in the high technology areas.

For some time, now, I am sure many of us have been struck by the Japanese commitment to introducing very young students to the science and math worlds. It is no wonder that the US turns to Japan, not only for electronic

components, but for highly sophisticated and finished instruments for commercial and private consumption. The Japanese have professionals to fill the research and development laboratories. Silicon Valley, as I understand it, is embroiled in corporate hiring wars because of the limited number of qualified personnel. Instead of billions for defencse, why not invest in our youth?

I am in full support of this effort, Senator Dominici and Committee Members. As Director of American Indian Scholarships, Inc., a program financially assisting Indian men and women graduate students nation-wide, I am acutely aware of the dearth of individuals working toward Master's and Ph.D. degrees in the areas of science and math.

Indian America's aspirations for good and strong education are no less than those in the non-Indian sector. This is the reason why it is so disheartening to have to inform you of a microscopic congressional appropriation of $29,044,00 for FY83 for Indian Higher Education. You are to be congratulated for the far-sighted and realistic educational cost of $230 million for the State of New Mexico alone.

Should I be able to be of any assistance to you, Senator and Committee, I sincerely hope that you will call upon me. It is my profound hope that your efforts will bear very much needed fruit.

#

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NATIONAL INSTITUTE FOR MULTICULTURAL EDUCATION
President / Executive Director
Tomás Villarreal, Jr.

TESTIMONY SUBMITTED

TO THE

UNITED STATES SENATE BUDGET COMMITTEE

FIELD HEARINGS

IN

ALBUQUERQUE, NEW MEXICO

ON

FEBRUARY 7, 1982

BY

TOMAS VILLARREAL, JR.
President/Executive Director

NATIONAL INSTITUTE
FOR
MULTICULTURAL EDUCATION

3010 Monte Vista, N.E. / Suite 203 / Albuquerque, New Mexico 87106 / (505) 262 1515

This written testimony is submitted by Tomás Villarreal, Jr., President/Executive Director of the National Institute for Multicultural Education (NIME) headquartered at 3010 Monte Vista, N.E., Suite 203, Albuquerque, New Mexico, 87106. NIME is a private, nonprofit, minority organization dedicated to promote equal educational opportunity and quality education for all children in the United States, particularly the linguistically and culturally distinct. For the last fourteen years, NIME has operated and managed programs designed to provide technical assistance and training to school district personnel, parents and community, school board members at the local and state levels, state legislators, and on several occasions to top state and federal officials including the Congress of the United States. NIME is recognized as a service and advocacy organization having participated in key court decisions related to bilingual education and equal educational opportunity such as the Denver vs. Keyes and the Lau vs. Nichols cases. In addition, NIME was involved in the development of the bilingual education regulations and guidelines which are still in effect today.

In a recent Wall Street Journal article entitled: "Schools, Businesses Dispute How Well Pupils are Trained,"[1] the argument was developed that the nation's corporations and school systems had some obvious differences about the quality of public education. According to the Center for Public Resources, 40% of 184 companies surveyed believed their secretaries have difficulty reading material at their job level. Half said their managers and supervisors could not write paragraphs without errors and

half said their skilled and semi-skilled employees, including bookkeepers, could not handle decimals and fractions. Schools (80%), in contrast, indicated that their graduates can read well enough to hold a job and 65% of the schools indicated that their graduates could write well enough to hold a job. Another 79% said their graduates have sufficient math skills to keep a job.

Susan Ueber Raymond, a Center for Public Resources vice president, suggested that corporations and schools must examine their differences by challenging the school system's assumption that they are adequately preparing students for employment and by establishing a corporate commitment of time resources, and follow-up to improve fundamental aspects of the school curriculum. The 184 companies surveyed believe, in general, that the schools are not teaching the skills that modern corporations require. Manual jobs requiring few reading or math skills are disappearing and corporations need "employees who have basic math, science, listening and reasoning skills to interact with expanded technology."[2]

In the past 10 years, the survey noted, the number of secondary math teachers entering the field has decreased by 78%. According to the survey of 123 school systems, 50% of the teachers newly assigned to secondary school math and science classes lacked the appropriate qualifications to teach the subject matter.

We are, again facing a crisis in public education and industry. How we respond to this crisis will have an impact for years to come. We must recognize and identify the needs and respond quickly and adequately to these needs without sacrificing or

misdirecting important resources.

Since this hearing is being held in New Mexico, we can assume that you are interested in the conditions within this state. Therefore, let us look at some aspects of this area which may be uniquely New Mexican.

Because of the state's geographical setting, educators are deeply concerned with the educational needs of students in small rural schools. At the same time, because of the state's ethnic composition, New Mexico educators are especially concerned about the educational needs of students whose cultural and linguistic background differ from the Anglo majority. Thus, the educational needs of the state are deeply rooted in rural bilingual, multicultural settings.

The rurality of New Mexico is evident in its ranking as a sparsely populated area in the United States. Currently, on the average, there are 10 inhabitants per square mile in the state. In this regard, it is ranked 45th in the nation with the nationwide average standing at 61.4 inhabitants per square mile. It is evident that New Mexico ranks far below the national average in this category. The resulting population distribution dramatically affects the sizes of the state's school districts--very few major urban districts and a substantial number of small, rural school districts.[3] Even the few urban districts are a mixture of urban and rural students. All cities in New Mexico can be classified as "Extended Cities," a Census Bureau classification which includes a "central city" and surrounding closely settled territory whose environment is primarily rural in character. In essence, all districts in New Mexico must address the

needs for delivering quality instruction to students from rural environments.

The ethnic composition of New Mexico schools clearly delineates the need for bilingual, multicultural programs. For example, nine languages are used in the schools--English, Spanish, Navajo, Keres, Tewa, Towa, Tiwa, Apache and Zuni. Ethnic diversity is also evident in the student population comprised of 120,523 Anglos; 107,423 Hispanics; 23,581 Native Americans; and 10,480 classified as other. In percentages, the figures are 46% Anglo, 41% Hispanic, 9% Native American and 4% other.[4] Although the minority ethnic groups separately are fewer in number to the Anglo majority, collectively minority groups are a majority. New Mexico is unique in that it is the only minority-majority state in the continental United States.

During the 1980-81 school year, 46 districts offered bilingual education programs funded by state or federal monies. There were a total of 26,476 students in state programs and 5,167 in federal programs. Nonetheless, expansion of bilingual programs is greatly needed in New Mexico. Traditional educational programs have failed to provide equal educational opportunity to students from a minority linguistic and cultural background. This fact is evident in such indicators as student attrition. For instance, Native American students have consistently experienced the highest dropout rates, and Hispanic students have experienced the second highest dropout rates. In percentages, the attrition rate is 14.9% for Native Americans, 8.1% for Hispanics, 7.6% for Blacks and 6.7% for Anglos.[5]

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In 1968-69, the 7,843 New Mexico students who took the ACT test scored above national norms in English, Mathematics, Social Studies, Natural Sciences, and Total Composite Scores. In 1980-81, New Mexico subtest averages in English, Mathematics, Social Studies and Natural Sciences were below national norms for the 10,692 students taking the test. While national means ACT scores have been declining in many areas, the relative scores in New Mexico have been declining at a faster rate.[6]

Unfortunately, the state is no longer willing to publish comparative ethnic data for the ACT. It, therefore, is difficult to reach any firm conclusions. We, in New Mexico, are sufficiently cognizant of group differences to report mean scores for men and women. However, the willingness to examine differences no longer is extended to ethnic/racial groups. We do know that 98% of the Anglos pass the New Mexico High School Proficiency Examination while 87% of Hispanic and 71% of the Native American students also pass.[7] We might apply those discrepancies to the ACT and other standardized tests as well.

The data on test score performance differences is presented only to establish some concept of comparative disadvantage. New Mexico students, in general, seem to perform below national averages on selected standardized tests. Minority students' scores tend to be lower than the scores of non-minority students. In this sense, then, minority students are at a greater disadvantage and poorly conceptualized plans to improve math and science performance will only increase the relative advantages/disadvantages.

One of the basic nationwide problems for the minority student is the apparent lack of models. This is also true in New

Mexico, especially in the educational realm. Although the student population is comprised primarily of minority students, the teaching staff is just the opposite. Of the 14,396 teachers, there are 10,365 Anglos; 3,455 Hispanics and 144 Native American teachers, as well as 432 classified as other. Overall, Anglos comprise 72% of the teachers compared to 24% Hispanic and 1% Native American.[8] This trend is also true in administrative positions. For example, 75% of the superintendents are Anglo, 24% Hispanic, 0% Blacks, Asians and Native Americans, and 1% other.

In essence, the educational problems of New Mexico are the problems of the nation magnified by geography, and racial/ethnic differences. If we are failing to prepare all students with basic math, science, listening, and reasoning skills; these failures are magnified in rural, multicultural New Mexico. If we are facing a shortage of math and science teachers in the United States, the shortage of Hispanic math and science teachers has always been acute. If there has been a decrease in the quality of math and science education, think about the Hispanic, Native American, and Black students who have never attained equality in education.

But, we already know there are problems. These hearings are an admission of the existence of a problem. I would like to offer a few brief recommendations to meet this "crisis":

1. I think we can reach essential agreement with Secretary Terrell Bell, the "problem is related to the fundamental need to provide more opportunities

for teachers to get some advancement and promotions."[9] We must make a long-range commitment to science and math education and provide incentives for teachers. However, we must also recognize the nature of the problem and make sure that the funds are directed to the districts with the greatest needs. Without this assurance, we will quite simply widen the gap between poor and non-poor, minority and non-minority schools.

2. We must provide for investments in laboratory equipment and resource centers for elementary as well as secondary students. We must involve business and industry in this effort. There can be corporate contribution of time, resources, and curricular development expertise. Corporations can provide some of the needed incentive by hiring science and math teachers during the summer. However, I am not convinced that scientific and mathematics experts will accomplish much as teaching volunteers. Scientific/ mathematical expertise does not necessarily translate into effective teaching skills. If we are willing to make a commitment to science and math education, we can identify teachers and provide training for these teachers.
3. While we often use test scores, we must proceed cautiously with this data. In the past, we have emphasized basic skills and passing tests. In

doing so, we have emphasized the learning of terms, concepts, facts, and principles. As suggested earlier, reasoning, thinking and problem-solving skills are necessary for interacting with expanded tecnology. If we proceed blindly, we may very well impare those students we are trying to help.

The shortage of math and science teachers must be a national, state and local responsibility. We agree with most educational leaders that the federal government must move vigorously in this critical area. The problem is a national concern and the actions must be initiated at this level.

References

1 Stephen Grover, "Schools, Businesses Dispute How Well Pupils Are Trained," Wall Street Journal, 14 January 1983, p.1.

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3 New Mexico State Department of Education, How New Mexico Stacks Up In Education, Santa Fe, New Mexico, 1981, p. 1.

4 New Mexico State Department of Education, New Mexico School District Profile: 1980-81 School Year, Santa Fe, New Mexico, 1981, pp. 1-11.

5 Ibid.

6 New Mexico State Department of Education, New Mexico 1980-81 ACT and SAT Results, Santa Fe, New Mexico, Spring, 1981, pp. 1-5.

7 New Mexico State Department of Education, New Mexico High School Proficiency Examination 1981-1982 School Year, Santa Fe, New Mexico, 1982, p. 2.

8 New Mexico State Department of Education, New Mexico School District Profile: 1980-81 School Year, Santa Fe, New Mexico, 1981, p. 9.

Submitted February 7, 1983

WRITTEN STATEMENT FOR THE RECORD:

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Ph. D. in laser physics, University of California, Berkeley (1971)
Volunteer coach of Pojoaque Elementary School Chess Team
(The team is current New Mexico State Champion and is eleventh in the nation).
Former lecturer, University of California, Davis
Parent of two children
Former volunteer tutor in math and sciences
Developer and teacher of advanced laser courses for Engineering Technology, Incorporated, Waco, Texas
Published over 45 refereed publications in the scientific literature
Editor of Academic Press book entitled: Optical Phase Conjugation

DISCLAIMER:

The statements prepared here represent those of the preparer, and in no way should these statements be construed as an official position of my employer, Los Alamos National Laboratory.

INTRODUCTION

Since I first volunteered to tutor children in 1959, I have been deeply concerned with the inability of many young students to comprehend and to appreciate concepts in mathematics and in science. I was further baffled by this, because these were the very subjects that I found easy. It was not until I recently volunteered to be an elementary school chess coach that some of these problems came clearly into focus.

Some of my suggestions to you today concern your possible support for chess in our elementary schools and some of my suggestions are of a much more general nature.

SUGGESTION #1: FEDERAL SUPPORT OF CHESS IN THE ELEMENTARY SCHOOLS

At this moment, the United States Chess Federation (Dr. Gerald J. Dullea, Executive Director, 186 Route 9W, New Windsor, New York 12550- phone (914) 562-8350) is undertaking a major effort to bring chess to more elementary schools. I propose that the US government directly support this effort by giving the USCF (a registered non-profit corporation) funds specifically earmarked for use in their elementary chess programs. The USCF is well-equipped to carry out this task, and this means that the role of the government is extremely simple; one needs to merely send them a check!

A). Why is chess valuable?- In addition to my own comments which follow, I have attached to this Statement copies of recent articles in Chess Life. The articles I selected pertained especially to children's chess.

I believe that the early years (especially grades K-3) are especially valuable years. It is in this age group that children are especially equipped to develop the cognitive skills associated complicated games of strategy. These children also have special capacity for spatial pattern recognition. In the normal schooling routine, these special skills are not accentuated, even though they are extremely important for those who later go on to mathematics and science study. I have also found that kids in the fifth or sixth grades often have much more difficulty in starting chess; the early years seem to be more germinal.

Once a child's interest in chess develops, there is a strong interest in learning to improve one's game. Each child learn by his or her mistakes, which means that each loss contains information for the child. I find that the child's attempt to identify (and correct) mistakes on the chessboard leads, out of necessity, to the child's first clear development of good study habits. This, in turn, gives the child a basis upon which the child can deal with subjects as seemingly confusing as mathematics and sciences. I have found many of the players on my team have significantly improved both their self-confidence and their grades.

In conclusion, elementary chess is valuable because it trains good study habits, it develops special talents (spatial pattern recognition, strategic decision-making, etc.) which are especially crucial in the preparation of tomorrow's math and science students.

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SUGGESTION #2: INCREASED SUPPORT TO THE EDUCATION SYSTEM

Although extremely expensive in comparison to suggestion #1, these remedies are nearly obvious:

A). Salaries for elementary teachers must immediately receive a significant increase. This makes the field more competitive and brings needed talent into the field.

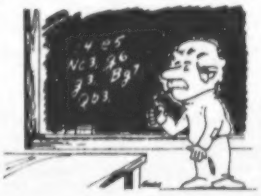
B). The tenure system must be abolished so that the new teachers created by "A" above can move into the system. Otherwise, the salary increase is of no immediate value.

C). Although computers are fun for the more sophisticated students, these machines are more valuable for remedial work and for exercising students in repetitive work such as spelling and times tables. These machines can readily occupy and drill a student while freeing the teacher for the teaching of more complicated and more personal subjects. Computer-aided teaching of repetitive work can easily score each student and can provide progress information to the teacher. Although some will claim that such teaching is "impersonal", it would be just the opposite since it will free the teacher for more personal interaction and it can guarantee to accurately evaluate the progress of each student. This proposal requires tremendous capital outlay, but the payoff is obvious.

D). Sophisticated studies must be undertaken to determine why young girls find themselves turned off in math and in science. It has always been shocking to me that half of our population has received such convincing cultural pressure that they do not feel competent to compete. Women have successfully cracked the "lawyer" barrier and the "physician" barrier, yet by the time they have finished primary school they have already erroneously convinced themselves that they are not capable of performing well in the sciences and in math. I have personally seen this barrier prevent very bright girls from doing well on my chess team! I do not know the answer to this problem, but is is more severe than any other minority issue since it affects one out of every two Americans! Studies must be made and remedies must be proposed.

Each of the suggestions on this page is difficult. Each will meet with much resistance, and each will be much more expensive than any one would like. Nevertheless, a chance at an education is something which only comes once to each child, and the loss of first-rate education in this country would be an unforgivable disservice to the entire nation.

FOCUS ON YOUTH



Chess Makes Kids Smarter

BY GERARD J. DULLEA

Chess lovers have long contended that chess should be a valuable classroom tool. It can provide an intellectually stimulating, rewarding activity, but it can also teach discipline, concentration, planning and all the other good things that go into successful chess.

In 1977, however, the National Institute of Education (NIE) argued against this position, saying in effect that good students and good chessplayers tend to be the same group simply because they are more intelligent and more intellectual than their classmates. NIE contended that transfer of skills is minimal, arguing that time spend on one skill detracts from the learning of another.

Some months later, Dutch scholar Adriaan de Groot wrote a rebuttal of NIE's position, basing his arguments on a careful two-year study in Belgium. Now, thanks largely to Harry Lyman of Massachusetts, in behalf of the Massachusetts Chess Association and the American Chess Foundation, the Flemish source of de Groot's argument has been translated into English.

The Belgian study was the doctoral thesis of Johan Christiaen, titled "Chess & Cognitive Development." It was a carefully controlled experiment with 20 students in the fifth grade in 1975, following them through the sixth grade the next year. As might be expected of a foundation for a doctorate in psychology, the test was carefully designed and executed, complete with a control group and other features of good experimentation.

Christiaen's aim was to use chess to test Jean Piaget's theory about cognitive development, or intellectual maturation. Piaget holds that an important growth period occurs approximately between the ages of 11 and 15. In this stage, the child moves beyond physical trial and error and begins hypothesizing and deducing, developing more complex logic and judgment. In Piaget's terms, the youngster moves from the "concrete" stage to the "formal" stage.

Piaget further contends that the environment of a child can speed up or slow down this maturation, so Christiaen proposed to vary environment with either chess or no-chess. If chess were the significant variable between two groups of youngsters, any significant difference in the development of the students could be attributed to enrichment brought by chess to their environment.

And it worked! In the words of Harry Lyman, "Learning chess makes kids smarter in the classroom!"

On 42 Friday afternoons, after school, Christiaen taught chess to 20 boys randomly selected from a group of 40. The other 20 were the control group, the one that would be compared. He did his best to keep these students ignorant of their experimental function.

In testing after the two years, the chess group scored somewhat better than the control group on various of Piaget's tests for cognitive development. More of a difference, however, was evident in their regular school testing! In the school testing, the chess group did significantly better in both the fifth grade tests and (somewhat less so) in the sixth grade tests.

Christiaen notes that some of this difference may be due to what Robert Rosenthal of Harvard calls "the Pygmalion effect." That is, teachers who may give special treatment to "special" students may get special results from those students.

On the other hand, classroom testing was supported by standardized testing administered by an outside agency, which did not know the identities of the two groups. On these tests too, the chess group performed better than the control group.

This study by Dr. Christiaen needs support, extension and confirmation. And other tests can be made too. For the moment, however, we have scientific support for what we have known all along — chess makes kids smarter! □

Dr. Gerry Dullea, USCF executive director, retains a special interest in educational matters from his years as a university professor.

Here are the key features of Christiaen's chess course:

Text: *Jeugdschaak (Chess for Youths)* by Berry Withius.

Time: One hour, after school, on Fridays, for 42 sessions.

Curriculum:

- The moves of the pieces.
- Exercises on mate.
- A complete game.
- Mandatory scorekeeping.
- Some theory in each lesson, gradually reduced in favor of exercises and games.
- Five sessions of simultaneous games against the instructor.
- Participation in two interschool tournaments.
- An intraschool championship, with final results displayed in the classrooms.
- Emphasis throughout that a beautiful game is more important than a victory. □

Kolty Needs Help To Continue A Good Start

BY GEORGE CUNNINGHAM

George Koltanowski, the Dean of American Chess, is not resting on his well-deserved laurels. Last year, he started a campaign to put chess in American schools. His idea was to use volunteers from our ranks to assist school teachers. The volunteers give the teachers basic instruction on how to teach youngsters to play and help organize the youngster's activities. Kolty also supports the volunteers with suitable chess material (sets and so forth) so that the volunteers do not have to spend money as well as time.

The program is off and running in a surprisingly large number of schools. Many, many school youngsters are profiting by this experience, which develops in them a desire to use their minds.

So far so good. However, the United States is a large country with thousands of schools and millions of youngsters. Kolty wants more programs. He will not be satisfied until every youngster has a chance at this valuable experience. He wants your help.

Can you write Kolty and volunteer your services as a "youth chess" participant? Can you contribute dollars to the Kolty Youth Fund, which backs up this and other efforts in behalf of American youth? Make your check out to The Charitable Trust, a tax-exempt foundation, to ensure your income-tax credit. Mail your letters and donations to Kolty, in care of the USCF, 186 Route 9W, New Windsor, NY 12550.□

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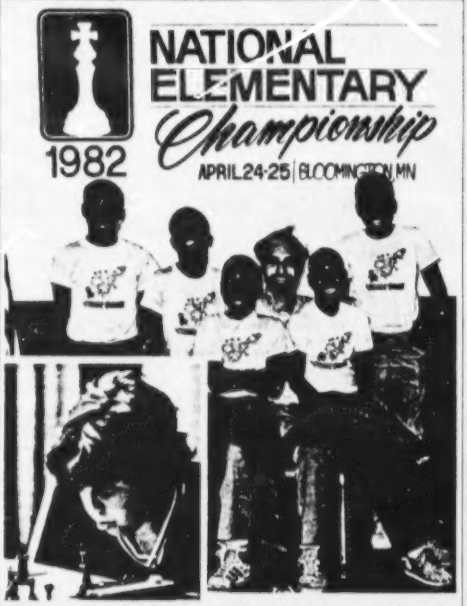


1982 National Elementary Champions, The Mighty Pawns, from Vaux, Philadelphia, (l-r): Anthony Westbrook, Maurice Graham, Kevin Hallager, Coach Steven Shutt, Christopher Harris and Alfred Moore. This is Vaux's sixth straight National Elementary title, won on tiebreak over Hastings of Hastings-on-Hudson, N.Y. PHOTO/BRUCE BERKE
Inset: National Elementary Champion Marco Robert of Trinity, New York, N.Y. Robert also placed 3rd in the National Junior High in Terre Haute, Ind. PHOTO/PHIL PIPPO

1982 National Elementary Championship

BY PHIL PIPPO

Three-hundred-fourteen of this country's best young chessplayers, along with their coaches and parents, gathered April 24-25 at the Howard Johnson's Stadium Motor Lodge in Bloomington, Minn., for the National Elementary Championship. Twenty-nine school teams from 11 states were entered in the eight round Swiss system.

Competition was exceedingly keen. The close of play found two teams — The Mighty Pawns of Philadelphia's Frederick Douglass and The Hudson Fish of Hastings, Hastings-on-Hudson, N.Y. — tied for top honors.

With the tournament hall sealed off, tiebreak procedures were implemented by Directors Rick Linden and Larry Lampert of the School Chess Association. The atmosphere around the pool and the video games grew tense for the first time as the teams awaited announcement of their final standings.

The results were so close that 20 minutes of calculations and rechecking were required before the directors could award 1st place — by a half-point margin — to The Mighty Pawns. Third went to Pilgrim Lane of Plymouth, Minn. Perennially strong Lincoln of Brooklyn Park, Minn., placed 4th.

In the individual competition, 1st place went to Marco Robert, a sixth-grader from Trinity in New York City, with 7 pts. Second place was captured by last year's champion, Kenneth Wright of Happy Hollow in Wayland, Mass. □

1982 SCHOLASTIC HONOR ROLL

NATIONAL ELEMENTARY
April 24-25 • Bloomington, Minn.

1st Team
Frederick Douglass, Philadelphia, Pa.
Hastings, Hastings-on-Hudson, N.Y.

1st Individual
Marco Robert, Trinity, New York, N.Y.

2nd Individual
Kenneth Wright, Happy Hollow, Wayland, Mass.

NATIONAL JUNIOR HIGH
May 1-2 • Terre Haute, Ind.

1st Ninth-Grade Team
Vaux, Philadelphia, Pa.
Woodrow Wilson, Terre Haute, Ind.

1st Ninth-Grade Individual
Andrew Metrick, Dix Hills, N.Y.
Issa Youseff, Ypsilanti, Mich.

1st Eighth-Grade Team
Martin, Crossville, Tenn.

2nd Eighth-Grade Team
Woodrow Wilson, Terre Haute, Ind.
Meany, Seattle, Wash.

1st Eighth-Grade Individual
Paul Homer, Nitro, W.V.
Stuart Rachels, Birmingham, Ala.

NATIONAL HIGH
April 16-18 • Philadelphia, Pa.

1st Team
Boston Latin, Boston, Mass.
Thomas Carr Howe, Indianapolis, Ind.

1st Individual
Sandeep Joshi, Dedham, Mass.
David Glueck, Cincinnati, Ohio
Simon Yelsky, Brooklyn, N.Y.
John Litvinchuk, Brooklyn, N.Y.

1st Novice Team
Hollidaysburg, Pa.

1st Novice Individual
Peter Arden, Hunter, N.Y.

YEAR OF THE VOLUNTEER

The Federation depends on its hard-working volunteers, and they all deserve recognition

ACROSS THE BOARD — USCF PRESIDENT TIM REDM

Last February 1 reported that the Policy Board had named 1982 as the year of the chess volunteer. The purpose is obvious. The Federation depends on its chess workers, and we hope to use this first theme year of the USCF as a way of giving our volunteers the honor and recognition they deserve. The response has been very gratifying so far.

Angelo Contoris

Angelo Contoris is the founder, president and guiding force of the Tri-State Chess Club in suburban Philadelphia. Like many of his counterparts, he comes early to club meetings and leaves late.

His congeniality is a major reason the club has grown to 60 members, most of them USCF members. A special difference in this case is that Angelo is paralyzed from the neck down. He does his inspiring work from his wheelchair. A category II player, he moves the pieces with a stick held in his teeth and keeps score the same way.

Our thanks to Dominic Sciaretta, his fellow club officer, for sharing Angelo's special story.

David Kowalczyk

David Kowalczyk is vice president of the Cleveland Chess Association. Don Collins of that organization credits Dave with taking it "from a shabby club of a half-dozen members" to "a beautiful club of nine teams!"

Dave is typical of the best chess volunteers, daring both to reach far and to stoop low. You'll find him cleaning up the supply closet or giving directions in the parking lot, always willing to do anything his club needs.

Both Angelo and Dave are examples of the club spark plug — the person who arrives early, puts out the sets and boards, greets visitors and stays late to clean and lock up. He or she is surely a familiar figure around the country, and one of our key volunteers.

But there are other kinds of volunteers, too, and we need all of them: the chess coach or teacher, editor or journalist, tournament director or organizer, patron or sponsor, committee member or state officer, USCF delegate or voting member.

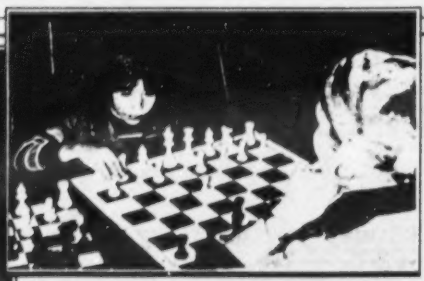
George Mirijanian

From being a USCF delegate and president of the Massachusetts Chess Association to setting up the club room weekly, George Mirijanian has done it all.

Evenings and weekends, George sees that things go smoothly for his clubs. A senior tournament director, he also freely shares his extensive knowledge of chess and its history. He types current standings in club tournaments and calculates "batting averages" for his players.

A former editor of *Chess Horizons*, most of George's current journalism is a weekly local chess column.

We share Kevin Caefer's fear that we will take George — or your volunteer — too much for granted. And we join Kevin as he says, "Thanks, George, for a job well done."



What do chess volunteers get out of their hard work? For one, the satisfaction of seeing all kinds of people enjoying themselves together. Shown above and on the facing page are members of a club organized by Arthur Rosenberg at the Brooklyn YWCA. Rosenberg sees chess as a means of drawing people of all ages, races and backgrounds together. Chess, he says "is a microcosm wherein all players must take their turns as Black and White."

There are problems as well as potential in our use of chess volunteers. We are all familiar with "volunteer burn-out." For one reason or another, a person stops functioning in an organization. I have seen chess clubs, magazines and even state associations collapse when one or two people withdrew. The solution is for more people to get involved. Many hands make light work.

In the coming months, you will get to read about some of our Federation's many chess workers. Will you help? Do you know a volunteer who contributes to your chess life? Send your story to: Volunteers, c/o *Chess Life*, 186 Route 9W, New Windsor, NY, and someone you know might be featured in a future issue. Each person nominated will receive a special certificate commemorating the year of the chess volunteer, and his or her part in it. His or her name will also be added to the "Honor Roll" of distinguished volunteers, which will be published in the December 1982 issue.

We're also interested in hearing from you chess workers. Why do you volunteer for chess? What do you get out of it? Why should others join you? And how can they help?

I close with a good example of a worker for chess.

Arthur Rosenberg

Art Rosenberg has written us about some of the rewards he gets from the chess club he organized at the Brooklyn YWCA. They are far-ranging and rewarding indeed.

He noticed that chess was a perfect way to implement the institution's credo: "The elimination of racism." He sees chess as a "microcosm wherein all players must take their turns as Black and White." He also liked the way chess is without bias regarding age, sex, handicap, ethnic origin or anything else.

His first idea was to provide an alternative activity for youngsters, something constructive and educational to replace boredom and mischief. But he found older players coming around too, and takes a special delight in the way everyone meets equally on the board and the way youngsters gladly share their knowledge with partners many times their age.

Art's conclusion is most eloquent:

"Seeing people get involved with one another through the medium of chess is personally gratifying. Sure, it would be fun if one of my 'proteges' should some day rise to international prominence, but there remains a far more down-to-earth level of satisfaction with the club which more than compensates for all my time and effort. Not to mention the fact that I happen to enjoy it." □

United States Chess Federation

USCF

186 Route 9W
New Windsor, N.Y. 12550

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United States Chess Federation

The United States Chess Federation is a registered not-for-profit corporation, whose purposes are educational and instructional, to broaden and advance chess as art and recreation, as a significant element of culture in America.

Membership is open to anyone, with benefits which include a subscription to *Chess Life* magazine (except for Participating Junior and Spouse members, and those who buy Tournament Membership) eligibility for a national chess rating, the opportunity to compete — official USCF postal chess tournaments, and many discounts from the *USCF Catalog of Chess Books and Equipment*.

Regular Membership: one year, $20; two years, $38; three years, $55. Junior & Scholastic (for those under 19 at expiration of a resident of the United States or Canada): one year $10; two years, $19; three years, $27.50. Participating Junior Membership (same as Junior, but without magazine subscriptions): one year $3. Spouse Membership (spouse of Regular, Life or Sustaining Members, without magazine subscription — spouse's identification number must be provided): one year, $10. Senior Membership (for those age 65 and over): one year, $10. Special Membership (for the blind): one year, $3.50. Tournament Membership (satisfies membership requirement for participation in a particular event by allowing non-members to have games rated — magazine subscription not included). Juniors, $1 for two games, all others, $1 a game.

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From the Editor

Chess Life Editor Fairfield W. Hoban

America's Dilemma

Our players can win world titles ... with your support

THE CANDIDATES' MATches are under way. The world will watch the drama of Korchnoi, Tal, Petrosian, Polugaevsky, Spassky, Portisch, Hubner and Adorjan struggling to survive ordeals of ever increasing intensity. Stamina, knowledge and the ability to cope with tremendous tension are prime requisites, and these are the ingredients that breath drama into these contests. But other elements are essential also: experience, psychological insight, intuition and years of singleminded, dedicated preparation.

Why are there no American contenders? For that matter, why have there not been any serious American challengers for the world championship since the abrupt end of the Fischer era? Are American players lacking in the qualities that make for chess greatness?

I don't believe it.

Time and time again, Kavalek, Tarjan, Biaguier, Browne, Christiansen, Seirawan, Diesen, Byrne, Soltis, Rogoff and many others have shown that they could defeat the best the world has to offer.

It's not a lack of ability or purpose or experience that blunts America's competitive edge in international chess, but a shortage of financial resources. Many other countries, especially those which consistently produce champions and challengers, subsidize their outstanding players. They establish learning centers where conditions for study are ideal, where chess ambiance is maximized.

Young players who show dedication and promise are given every opportunity to realize their potential. And, when they show this promise in the competitive arena, they receive sufficient assistance so that their energies can be concentrated on one goal — chess mastery.

Chess history since 1948 shows that, by and large, this has worked, and those countries lacking a program of governmental support have fallen behind in the competitive marathon.

But they have not been eliminated. The United States can produce a Bobby Fischer who can win the world championship against formidable odds. Great Britain can send forth an Anthony Miles to electrify the world by playing 1. ... P-QR3 against a world champion — and winning.

The ever increasing enthusiasm for chess in this country has produced an impressive group of young players who are now reaching their chess maturity. Yasser Seirawan, when only 19, was recently accorded the signal honor of being chosen by Korchnoi as his second to help him prepare for his match with Petrosian. Diane Savereide, America's highest ranking woman player, has been achieving remarkable results in international competitions.

In a short span of years, Seirawan and Savereide may be contenders for the world championship themselves. And they will have excellent chances of winning — provided, of course, they receive the support and help that is so essential.

Organizations such as the American Chess Foundation, the Chess Set Educational Trust and the United States Chess Federation have long labored to support chess and chess players of unusual ability. Contributions to them can have maximum effect in our common effort to seek out, encourage and support American chess genius. ■

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The Youngest Masters

Ordinarily, the emergence of a new master is accompanied by little fanfare. This significant milestone in the life of a chess player occurs silently when USCF's computer finishes a rating program. The names of those players whose rating reached 2200 are printed out and, if it's the first time their rating has reached this level, they are issued a certificate as proof of their high achievement.

However, when the new master is a player like John Jarecki or Stuart Rachels, the event is greeted with a little applause and a few words of congratulations. After all, the distinction of being America's "youngest master" is one accorded to only a few rare individuals.

This summer, lightning struck twice. The record previously established by John Litvinchuk (see the February 1980 issue) fell to John Jarecki, whose result at the World Open in July helped push his rating over 2200. In August, Rachels, who is about eight months younger than Jarecki, went 3-0 in a qualifying event for the Birmingham City Championship to achieve his first master's rating.

Following are reports on two players about whom you may be hearing more in the future.

BY BRUCE PANDOLFINI

There are hundreds of good chess players in this country, but only one of them is the youngest rated master in history. His name is Stuart Rachels, and he doesn't come from those traditional breeding grounds of young talent, New York and California.

He hails instead from Alabama.

Stuart earned the coveted master's title last August, and, because he was only 11 years and 10 months old at the time, he became the first chessplayer in the history of the USCF rating system to reach the 2200 level before the age of 12.

Although Stuart Rachels was born Sept. 26, 1969, in Manhattan, he is not really a New Yorker. He, like the rest of his family, is a Southerner. He was born in New York while his father, Jim, was teaching in the philosophy department at New York University. The family moved to Miami when Stuart was 2, and then to Birmingham when he was 7.

Stuart didn't learn how to play chess until just before his 9th birthday. Although his father is an experienced player, it was actually his older brother David who first taught Stuart how to play. (A promising player himself, 14-year-old David currently sports a rating around 1900.)

Shortly after learning the basics, Stuart started beating his brother. He also developed a fascination for chess literature. His favorite is Bobby Fischer's *My 60 Memorable Games*, but the first book that really interested him was Fred Reinfeld's *Complete Book of Chess Stratagems*, a collection of 500 tactical situations that he literally memorized within a few weeks.

A curious thing happened while Stuart was working his way through Reinfeld's book. He started to draw analogies between tactics he saw in the book and those he encountered on the board. He even composed positions with related themes and then put these problems to his father, Professor Rachels, currently dean of the School of Humanities at the University of Alabama in Birmingham as well as author and editor of several books on ethics, soon

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Stuart Rachels

John Jarecki

At age 13, John Jarecki has a trophy case that would be the envy of many a chessplayer. He has won national titles, participated in international matches and played on an olympic team. He has played in world championships, given simultaneous exhibitions and been the subject of feature segments on national tv.

And, in July of 1981, he became the United States' youngest master ever. His 5½-3½ score in the World Open in July gave him the title at 12 years, six months, beating by one month the record set in 1980 by John Litvinchuk. Although this record was eclipsed one month later by Stuart Rachels, it remains a remarkable accomplishment that attests to the young player's dedication, hard work and talent.

John learned chess at age 6 from his father, Dr. Richard Jarecki, a doctor who shared the Dag Hammarskjoeld prize for International Cooperation in Medicine with the renowned South African heart surgeon, Dr. Christiaan Barnard. The family was then living in Heidelberg, West Germany, where Dr. Jarecki was doing research in forensic medicine at Heidelberg University.

Upon returning to the States, the Jareckis settled in Harrison, N.Y., where John got his first taste of real chess competion. He started going to the Westchester Chess Club, and there he met chess teacher Sunil Weeramantry, who has served as John's coach ever since.

Active Schedule

John's first major success was in 1976 at the North American Scholastic Championship. He won 1st in the primary division with a startling 8-0 score, even though he was the second lowest rated player at 792.

From there his rating has soared, and the trophies and titles have accumulated at a steady pace. A short run-down of his busy schedule of the past three years bears the mark of a professional:

1979: With the encouragement of New York chess organizer Bill Goichberg, John got a broad chess experience by playing in the World Open (scoring 4-6), the

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STUART RACHELS

CONTINUED FROM PAGE 15

began to realize that his son might have a real talent for chess.

A subsequent incident reinforced this impression. Soon after his 9th birthday, Stuart met Grandmaster Larry Christiansen, who was in Birmingham for an exhibition. As president of the local chess club, the elder Rachels served as host to the visiting star. On one trip around town Stuart took the opportunity to hit Christiansen with a barrage of chess questions, including: "What is the shortest game you ever played?" Christiansen obligingly rattled off a 10-move miniature he had won, to which Stuart excitedly chimed, "Nice game!"

Perhaps because he was unable to visualize the moves himself, Mr. Rachels asked Stuart if he had really followed the game. To everyone's surprise, Stuart quickly recited the moves — and added his own critical comments along the way! That was proof enough for Jim.

Leaps and Bounds

With some trepidation, Stuart went to Atlanta in January of 1979 to play in his first tournament. By winning all his games he came away with a trophy, an 1100 rating and an unquenchable thirst for chess.

In September 1979, while still 9, he won the under 1600 section of the Alabama Open. Less than a year later, he won the Birmingham city championship by defeating a solid 2100 player. Steve Hudson (currently a graduate student at the University of Chicago), in a match by the score of 3-0!

Stuart's experience has not been confined to local events. In 1980, for example, he played in both the World and U.S. Opens. He also had the pleasure of playing on a team assembled by veteran chess coach John W. Collins against a team of young chessplayers from Iceland. Stuart not only learned quite a bit about competitive play; he also got a real kick out of meeting Collins and Grandmaster William Lombardy (who, by the way, awarded one of Stuart's efforts the "best played-game" prize).

Stuart is also no stranger to simultaneous play. He gave his first exhibition in Birmingham at age 9 and won all 19 games he played. At 10, he played 50 games at Huntsville, Ala., and after seven hours had lost only two. Last year in Anniston, Ala., he took on a field of 49, many of whom were rated players, and finished with 43 wins and three draws!

But chess is hardly his only interest. Apart from his phenomenal chess ability, Stuart seems to be a well-adjusted 12-year-old. James Rachels describes his son like this:

"Stuart is now a seventh-grader at Ira F. Simmons Junior High School in Jefferson County, Ala. He makes mostly A's in his school work. He is a vegetarian because he doesn't approve of killing animals; he is an avid fan of the television program "M*A*S*H*"; and he enjoys following the news. He likes baseball and ping-pong and tennis."

One question inevitably arises when a chess prodigy appears on the scene: How far can he go? Stuart is the highest rated player in Birmingham, and partly for this reason it will be difficult for him to maintain a high rating — in fact, his rating has subsequently dipped below 2200. Thus far he has not had any formal instruction (although he has benefited from the help of some Birmingham players, especially Ellis Jones and Dana Therrell, a candidate master who is now Alabama state champion), and has had few opportunities to meet first-class competition. Whether he will continue to make further rapid progress under such conditions remains to be seen.

> 'Right now I'm just trying to become a solid master.'

Stuart's attitude and approach to the game, however, are enormously promising. "Chess itself is a science," he remarks, "but a game of chess is a work of art." His goals: "Right now I'm just trying to become a solid master."

Here are some samples of his mature style:

March 1981
Sicilian Defense

D. Therrell/2030 — Rachels

1. e4 c5 2. c3 Nf6 3. e5 Nd5 4. d4 cxd4 5. Qxd4 e6 6. Nf3 Nc6 7. Qe4 d6 8. Nbd2 dxe5 9. Nxe5 Nf6 10. Qe4 Qc7 11. Ndf3 Bd6 12. Nxc6 Bd7 13. Bg5 Rac8 14. Bb5 Nd5 15. Nd4 0-0 16. Nxc6 bxc6 17. Bxc6 Nac3 18. bxc3 Rxc6 19. Bf3 Qxc3 + 20. Ke2 Qb2 + 21. Bd2 Rc2 22. Rad1 Bb4 23. Qd7 Be5 24. Be4 Rd8 25. Qxd8 + Bxd8 26. Bxc2 Qxc2 27. Rdb1 Bb6 28. Rhc1 Qe4 + 29. Be3 b6 30. Rb3 Bxe3 31. Rxe3 Qxg2 32. Rc8 + Kh7 33. Rc7 a5 34. Rxf7 Qxh2 35. Rxe6 Qh5 + 36. Rf3 Qb5 + 37. Rd3 Qc4 38. Re5 Qxa2 + 39. Ke3 a4 40. Ra5 Qc4 41. Ra8 Qb4 42. Ra6 Qc5 + 43. Ke2 h5 44. f3 h4 45. Kd2 Qb4 + 46. Ke3 h3 47. Rd4 Qe1 + 48. Kf4, **White resigns**

April 1981
English Opening

Daniel/1920 — Rachels

1. c4 Nf6 2. Nc3 g6 3. Nf3 Bg7 4. d4 0-0 5. e4 d6 6. Be2 Nbd7 7. 0-0 e5 8. d5 Ne8 9. Rb1 a5 10. a3 f5 11. b4 f4 12. Qc2 g5 13. Na4 g4 14. Ne1 Qh4 15. f3 g3 16. h3 Rf6 17. c5 Rh6 18. cxd6 Ndf6 19. Bb5 Nxd6 20. Nc3 Nf7 21. Nd3 Ng5 22. Re1 Bxh3 23. Nxe5 Bc8 24. Kf1 Qh1 + 25. Ke2 Qxg2 + 26. Kd1 Qxe2 + 27. Kxe2 Rh2 + 28. Kb3 Nh5 29. Nd3 Nxf3 30. Bxf4 Nxe1 31. Rxe1 Nxf4 32. Nxf4 Be5 33. Nd3 Bd4 34. e5 g2 35. Ne2 Rh1 36. e6 c6 37. Bc4 cxd5 38. Bxd5 Kf8 39. b5 Rxe1 40. Nxe1 g1 = Q 41. Nxg1 Bxg1 42. Nf3 Bc5 43. Ng5 Ke7 44. Nxh7 Bxe6 45. Bxe6 Kxe6, **White resigns**

February 1981
Sicilian Defense

B. Sides/2033 — Rachels

1. e4 c5 2. Nf3 d6 3. d4 cxd4 4. Nxd4 Nf6 5. f3 Nc6 6. c4 Qb6 7. Nc2 g6 8. Nc3 Bg7 9. Rb1 0-0 10. Be3 Qc7 11. Qd2 Ne5 12. b3 a6 13. Nd4 Bd7 14. Be2 Nc6 15. 0-0 Rab8 16. Rfd1 Rfc8 17. Rbc1 Qa5 18. Nxc6 Bxc6 19. Bg5 b5 20. Bxf6 Bxf6 21. Nd5 Qxd2 22. Nxf6 + Kg7 23. Rxd2 Kxf6 24. Rdc2 b4 25. c5 Bb5 26. Kf2 Ke6 27. Bc4 + Bxc4 28. Rxc4 d5 29. exd5 + Kxd5 30. Ke3 Kc6 31. Re4 Rc7 32. Kf4 a5 33. g4 Rd7 34. Rc2 Rbb7 35. Kg5 h5 36. h3 Rd5 + 37. Kh6 hxg4 38. hxg4 e6 39. Rxe6 Rbd7 40. g5 Rd3 41. f4 R7d5 42. Kg7 Rf5 43. Re4 Rc3 44. Rf2 Rcxc5 45. Rg2 Rc3 46. Rf2 Kd5 47. Re5 + Rxe5 48. fxe5 Rg3 49. Kf6 Rg4 50. Rd2 + Ke4 51. Kxf7 Rxg5 52. Kxe6 Rxe5 + 53. Kf6 Rd5 54. Rg2 g5 55. Ke6 Rc5 56. Kd6 Rf5 57. Rg4 + Kf3

And Black won in 72 moves.

March 1980
Nimzo-Indian Defense

R. Coupland/2024 — Rachels

1. d4 Nf6 2. c4 g6 3. Nc3 Bg7 4. e4 d6 5. f3 0-0 6. Bd3 e5 7. d5 Nbd7 8. Bg5 Nc5 9. Nge2 Nxd3 + 10. Qxd3 Bd7 11. 0-0 Qe7 12. Kh1 Rad8 13. Rf2 Ng4 14. fxg4 Qxg5 15. h3 f5 16. gxf5 gxf5 17. Ng1 fxe4 18. Nxe4 Qg6 19. Raf1 Rxf2 20. Rxf2 Rf8 21. Nf3 Rf4 22. Re2 Bf3 23. Nfd2 Rh4 24. Re3 Kh8 25. Qe2 Bb6 26. Rg3 Bxe4 27. Rxg6 Rxh3 + 28. Kg1 Be3 + 29. Qxe3 Rxe3 30. Rg4 Bd3 31. Nf3 Re2 32. Ng5 Bg6 33. Ne6 Rxb2 34. Nxc7 e6 35. c5 dxc5 36. Rc4 b5 37. Na8 Bf7 38. Nc7 Rd2 39. Re4 Bxd5 40. Rxa6 Rxg2 + 41. Kf1 Rxa2

And Black won in 56 moves.

Following is the encounter that won the "best played game" award from the match between young American and Icelandic players:

July 1981
Sicilian Defense

Rachels — Halldor Einarsson/Iceland

1. e4 c5 2. c3 d5 3. exd5 Qxd5 4. d4 cxd4 5. cxd4 Nc6 6. Nf3 Bg4 7. Nc3 Bxf3 8. gxf3 Qxd4 9. Qxd4 Nxd4 10. Nb5 0-0-0 11. Nxd4 Rxd4 12. Be3 Ra4 13. Rc1 + Kd8 14. Bb5 Rxa2 15. 0-0 e5 16. Rfd1 + Ke7 17. Bc5 + Kf6 18. Bxf8 Nh6 19. Ba3, **Black resigns** □

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JOHN JARECKI

CONTINUED FROM PAGE 13

Philadelphia International (3-7), the Marshall Chess Club June Open (2½-1½) and the New York State Championship (3-3). He also placed 2nd at the National Elementary Championship, and 2nd in the Class B section of the U.S. Class Championship. In all, he played more than 125 tournament games that year and pushed his rating up 300 points.

1980: John became the first player ever to win both the National Elementary and National Junior High championships, brushing away all competition with 8-0 performances. In addition to a regular schedule of weekend Swissers, he found time to participate in a telephone match between young British and American players and, through his uncle's residency status in the British Virgin Islands, he got his first taste of international competition. He represented the BVI in the World Under 14 Championship, placing 9th. And his crowning achievement was an impressive 7-7 score on Board 3 for the BVI team at the Malta Olympiad. He finished 1980 with a rating over 2000.

1981: John repeated as the National Junior High champion and again represented the BVI in the World Under 14 Championship, placing 2nd this time. In addition to gaining a USCF master's title, his results against FIDE-rated players in the World Open and the CCA Summer International is expected to give him a FIDE rating of 2235 when the next list appears early in 1982. He continued his active tournament schedule, gave some simultaneous exhibitions, and appeared on "NBC Magazine," hosted by David Brinkley, in June.

Scholastic Excellence

All this attention to chess, however, has not been to the detriment of his school work. John is an honors student in ninth grade at Bayshore (N.J.) Junior High, having skipped the eighth grade. Last year he was eligible to take part in the annual "talent search" held by Johns Hopkins University. He scored higher on the Scholastic Aptitude Tests than the average college-bound 12th grader, and thus qualified to take special classes at Johns Hopkins during the summer.

John now lives in Red Bank, N.J., where his family, which includes his mother, Carol, and sisters Didi and Lianna, moved in 1978. His father is now involved in the commodity brokerage business, and his mother has become actively involved in directing chess tournaments.

John loves sports, especially soccer, tennis, baseball and water and snow skiing and likes to fish and swim. His favorite pro teams: the New York Yankees and the Dallas Cowboys.

Still, chess consumes a good deal of his time. He studies regularly and maintains a steady diet of tournament chess. His instruction by Weeramantry continues, and this has been supplemented by sessions with Grandmasters Lev Alburt and Edmar Mednis.

His ambition? To be a lawyer — and, of course, a top-level chessplayer.

One gets the impression that he just might succeed.

One gets the impression that he just might succeed.

Here are some recent examples of Jarecki's winning style. In the first game, John comes up with a theoretical novelty on Move 13 that previously has escaped grandmaster scrutiny. (For another look at the opening, see the May 1981 issue, page 24.)

September 1981
Sicilian Defense

Jarecki	Frumkin/2206

1. e4 c5 2. Nf3 Nc6 3. d4 cxd4 4. Nxd4 e5 5. Nb5 a6 6. Nd6+ Bxd6 7. Qxd6 Qf6 8. Qd1 Qg6 9. Nc3 d5 10. Nxd5 Qxe4+ 11. Be3 Nd4 12. Nc7+ Ke7 13. Qd3 Nxc2+ 14. Kd2 Bf5 15. Bc5+ Kf6 16. Qd6+ Kg5 17. b4+ Kh5 18. Be2+ Bg4 19. f3 Qf4+ 20. Kxc2 Bf5+ 21. Kb3 Qg3 22. Bf2 Qxg2 23. f4+ Bg4 24. Qxe5+ Kh6 25. Qg5, mate

July 1981
Queen's Gambit

Youngworth/2401	Jarecki

1. d4 d5 2. c4 e6 3. Nc3 Be7 4. Bf4 Nf6 5. e3 0-0 6. Nf3 b6 7. Rc1 Bb7 8. cxd5 exd5 9. Bd3 c5 10. 0-0 Nh5 11. Bg3 Nxg3 12. hxg3 c4 13. Bb1 f5 14. Ne5 Nd7 15. f4 g6 16. Qf3 Nf6 17. g4

PLEASE TURN TO PAGE 18

The Youngest Masters

August 1906:	Robert Fischer	(13 years, 5 months)
July 1977:	Joel Benjamin	(13 years, 5 months)
November 1979:	John Litvinchuk	(12 years, 7 months)
July 1981:	John Jarecki	(12 years, 6 months)
August 1981:	Stuart Rachels	(11 years, 10 months)

Other Young Masters

October 1964:	Walter Browne	(15 years)
November 1967:	Kenneth Rogoff	(14 years, 8 months)
July 1972:	Peter Winston	(14 years, 3 months)
July 1973:	Kenneth Regan	(13 years, 9 months)
February 1976:	Michael Wilder	(13 years, 6 months)

Teaching The Young Masters

BY ALBERT LAWRENCE

Sunil Weeramantry is a chess teacher who doesn't have to advertise. His students do that for him. Six are rated in the top 50 under 13; five are in the top 30 of that list.

Five years ago Weeramantry, who works full time as an administrator at the State University at Purchase, New York, started teaching John Jarecki, now the youngest player with a current rating of master (see story, this page). When they first began working together, the youngster knew only how to move the pieces.

Weeramantry, 30, now teaches chess 20-30 hours a week at three school districts, working only with pre-teenagers. "Some of the kindergarten players are pretty strong," Weeramantry says.

"They should be — some have been studying with him since nursery school.

"When teaching the very young, I show them how to identify the pieces and how to move some of them. We take it slowly and have fun. All I try to do in the public schools is get everyone enthusiastic and excited."

Weeramantry, New York State champion in 1974, says that a good teacher must always "concentrate on the strong-points" of a young player. And winning should be de-emphasized.

He stresses that young players often feel the burden of their parents' or teachers' high expectations. "Please tell people not to run over to their child's board immediately after a loss to show what should have been played. Wait. Talk it over the next day," he said.

"Offer encouragement and help children get satisfaction even from a defeat by focusing on the quality of a game, not its result. And don't burden them with a lot of books and variations."

Weeramantry is optimistic about the future of chess in the schools. "Every school and PTA is looking for extra-curricular activities. They simply must be approached and have chess presented as an attractive proposition." The benefits of chess? Weeramantry says that it can strengthen a student's concentration, analysis and logic. It also teaches young people to "make a choice based on an assessment," Weeramantry said. "That is a real-life, transferable skill." □

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JOHN JARECKI

CONTINUED FROM PAGE 17

fxg4 18. Nxg4 Nxg4 19. Qxg4 Kh8 20. Qh3 Qd6 21. g4 Qf6 22. g5 Qg7 23. Rc2 Rad8 24. Rg2 Bc8 25. f5 Bxf5 26. Bxf5 gxf5 27. Rxf5 Qg6 28. Rgf2 Rxf5 29. Rxf5 Bxg5 30. Kf2 Rg8 31. Nxd5 Bd8 32. Kf3 Qg1 33. Rf7 Qd1+ 34. Kf4 Bg5+ 35. Ke5 Qd3 36. Qf5 Re8+ 37. Kd6 Qxf5 38. Rxf5 Bxe3 39. Nxe3 Rxe3 40. d5 c3 41. bxc3 Rxc3 42. Kd7 Kg7 43. d6 Kg6 44. Rf2 h5 45. Ke8 Re3+ 46. Kd8 Rc3 47. d7 b4 48. Ke8 Re3+ 49. Kf8 Rd3 50. Ke7 Re3+ 51. Kd6 Rd3+ 52. Kc7 Rc3+ 53. Kb8 Rd3 54. Kc7 Rc3+ 55. Kd6 Rd3+ 56. Ke7 Re3+, draw

July 1981

Queen's Gambit

Bauer/2276 — Jarecki

1. d4 d5 2. c4 e6 3. Nc3 Nf6 4. cxd5 exd5 5. Bg5 Be7 6. e3 0-0 7. Qc2 Re8 8. Bd3 h6 9. Bh4 c6 10. Nge2 Nbd7 11. 0-0-0 b5 12. f3 Bb7 13. e4 b4 14. e5 bxc3! 15. exf6 cxb2+ 16. Qxb2 Nxf6 17. Bxf6 gxf6 18. Qxb7 Ba3+ 19. Kc2 Rb8 20. Qxa7 Ra8 21. Qb7 Rb8 22. Qa6 Rb2+ 23. Kc3 Rxa2 24. Kb3 Qb8+, White resigns

July 1981

Queen's Gambit

Parnuljens/FIDE 2220 — Jarecki

1. d4 d5 2. Nf3 e6 3. c4 Nf6 4. Nc3 Be7 5. Bg5 0-0 6. e6 h6 7. Bh4 b6 8. Bd3 Bb7 9. 0-0 Nbd7 10. Rc1 c5 11. b3 Ne4 12. Bxe7 Qxe7 13. cxd5 exd5 14. Bb1 Rfd8 15. Qe2 Rac8 16. Qb2 f5 17. Rfd1 Ndf6 18. Ne5 g5 19. f3 Nd6 20. Ne2 Rc7 21. Qd2 Bc8 22. Ng3 h5 23. Re1 Qg7 24. Kh1 h4 25. Ne2 Bd7 26. Nc3 Be6 27. Na4 Nb5 28. Nd3 c4 29. Ne5 b5 30. Nc5 Bc8 31. Qf2 Ne8 32. b4 Nd6 33. a3 Rf8 34. Bc2 Qh6 35. a4 a6 36. Ra1 Nf6 37. axb5 axb5 38. Ra5 g4 39. Qe2 Nb5 40. Qd2 gxf3 41. Nxf3 Nf6 42. Ng1 Nfe4 43. Qe2 f4 44. Bxe4 dxe4 45. exf4 Raf4 46. Qd2 Qf6 47. Ra3 Rg7 48. Re2 Bg4 49. Re1 Bh5 50. h3 Rf2 51. Qe3 Rgxg2 52. Ra8+, and White resigns

November 1981

Sicilian Defense

Krauss/2215 — Jarecki

1. e4 c5 2. Nf3 e6 3. d4 cxd4 4. Nxd4 Nf6 5. Nc3 d6 6. Be2 Be7 7. 0-0 0-0 8. Be3 Nc6 9. f4 Qc7 10. Bf3 Bd7 11. Qe1 Nxd4 12. Bxd4 e5 13. Be3 exf4 14. Bxf4 Bc6 15. Kh1 Rfe8 16. Rd1 Nd7 17. Qf2 Ne5 18. Nd5 Bxd5 19. Rxd5 Bf6 20. Rfd1 Red8 21. c3 Qc6 22. Be2 a6 23. Be3 Rd7 24. Bd4 Re8 25. Qf5 Rc6 26. b3 Ng6 27. Qf2 Bxd4 28. Qxd4 Ne5 29. c4 Kf8 30. a4 b6 31. Qd2 a5 32. Qd4 Qc7 33. Rb5 Qd8 34. Rxb6 Qb4 35. g3 Qb3 36. Bf1 Qg4 37. Bg2 Rb8 38. Kg1 Qb3 39. h3 Qg5 40. Rf1 Qxg3 41. Qf2 Rxb1 42. Qxg3 Rxg3 43. Rb5 Nc6 44. Rd1 Ke7, and White lost on time

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Benjamin's Breakthrough

Being the youngest player in the field proves no disadvantage for this 16-year-old senior master

1980 U.S. Junior Championship

THE 1980 U.S. JUNIOR invitational Championship continued a recent trend by sporting a stronger field than ever before, with five senior masters.

By Michael Wilder

The generosity of the American Chess Foundation, the Fleischer Foundation and the USCF made this event possible by providing the necessary funding, and Lina Grumette contributed the world famous Hollywood Chess Set Club for the playing site.

Jerry "Parting with the Lady" Hanken was once again the chief organizer, and the fact that everything went smoothly is a tribute to him and to the director, Isa Nethercott. The educational benefits to the participants of this tournament were enhanced by the A.C.F.-funded presence of Lev Alburt, the highest rated player in this country, who helped the players analyze their games and gave seminars on off days.

This year's U.S. Junior Invitational was won by Joel Benjamin of New York, who, at 16, is one of the youngest winners of all time. He and his second will receive an expenses-paid trip to the World Junior Championship in Germany this summer.

Although he was the youngest participant, Benjamin scored an amazing 5½ out of 7 pts. against the strongest U.S. junior competition to date. His lack of specific theoretical knowledge did not prevent him from getting good positions in most of his openings and, on the few occasions when he was forced to defend, he outplayed his opponents in the late middlegame, often while in time pressure! He has a sharp, original attacking style, balanced by a solid positional intuition.

A favorite backdrop for snapshots at the Chess Set is this portrait of a familiar world champion (above). Joel apparently had difficulty keeping a straight face when Jerry Hanken suggested a pose. At right, 2nd place finisher Douglas Root

Benjamin's victory was achieved through a last-round win over Douglas Root, 17, of Diamond Bar, Calif., who is a hardworking, studious competitor. Showing remarkable resourcefulness throughout the tournament, Root held together several lost positions and very nearly managed to survive in a clearly inferior position in that crucial last-round game. His ideas and his play (especially his openings) can be described as highly unusual. Root finished with an impressive 5 pts., good enough for 2nd place and an expenses paid trip to the 1980 U.S. Open.

I made one of the worst blunders of my career in my game against Root, marring an otherwise reasonable tournament for me. Despite this, I finished with 4½ pts. and took home the $300 3rd prize.

Jay Whitehead, 18, of San Francisco, and Jim Rizzitano, 19, of Needham, Mass., tied for 4th with 4 pts. each.

Finally, it should be mentioned that the United States may have two representatives to the World Junior this year. If Benjamin should win the World Under-17 Championship in France this summer, then he will have qualified for the World Junior twice. This would allow another participant to assume Benjamin's position as U.S. Junior Invitational representative.

Blunders

Almost everyone in the tourna-

Michael Wilder, 17, of New Jersey, is the fifth highest rated player under 21 in America today. He has been a master since age 13.

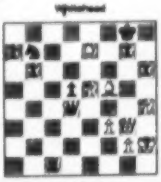
ment was, to some extent, unhappy with his play. The following are a few of the more horrendous blunders that generated the dissatisfaction.

Youngworth

Whitehead
White to move

Black has been up a Queen for a Rook since shortly before adjournment and has a winning position. In desperation, White played 48. Ne6, to which Black replied 48. ... Qe7?? (most random Queen moves, such as 48. ... Qc3, win without trouble). After 49. Rxd7 Qxd7 50. Nf8 +, Black had to resign.

Whitehead



Benjamin
Black to move

Black, who had held the initiative throughout the game, managed to convert his pawn plus to a winning edge, helped by White's severe time problems. In this position, he saw 36. ... Qg1 + 37. Kh3 Qh1 + 38. Kg4 Rg1! winning but, looking further (unfortunately), saw something "easier" and played 36. ... Qa1??. After 37. Be6 + Kh8 38. Qf4, White had a winning position. As White was playing at a rate of one second per move (he hardly had time for more), Black continued until the time control. The remaining moves were 38. ... Rh1 + 39. Kg3 Qe1 + 40. Kg4 Rxb4 + 41. Bxb4 Qxb4 + 42. Kxb4 g5 +, and Black resigned.

Finally, the tournament was decided by a blunder. In the final round, Benjamin had 4½ and needed a win against Root to overtake him in the standings. As there were no others capable of scoring 5½, 1st place would go to Root or Benjamin.

Benjamin obtained a clearly better position in the opening but later dissipated some of his advantage through a few inaccuracies. Although he held all the positional trumps at adjournment, the position was so locked up that there was no way to press for a win. Our analysis team, which included Benjamin, abandoned the game as a draw. When play resumed, Benjamin tried a winning plan that we had not considered.

Root

Benjamin
White to move

White had sealed 41. Rh5, and Black responded with the predictable 41. ... Kg7, reaching the position above — the one we had analyzed the night before. Benjamin continued with:

42. Rh1 Kg6 43. Nf3 Rh7 44. Nh3 Nh5

Black might have drawn by putting his Rook on e7 and the King on g7.

45. Nh4 Rd7?

As in the previous note, the Rook belongs on e7.

46. Ng5 Nc7 47. Rf1! Ne6?

The final blunder. Although Black has clearly not put up the best defense, his position may still have been tenable after 47. ... Rg7 and on 48. Rf6 Nb5!

48. Rxf8 + ! Kxf8 49. Nxg6 + Kg8 50. Nxe6

Black has a hopeless position.

50. ... Nc7 51. Nxc7 Rxc7 52. Nf4

White went on to win without trouble.

HERE ARE TWO GAMES from the event. Notes to the first one are based on those by Benjamin.

Closed Sicilian

Benjamin	Youngworth
1. e4	c5
2. Nc3	d6
3. f4	Nc6
4. Nf3	

All About Benjamin

At age 16, Senior Master Joel Benjamin, of Brooklyn, N.Y., has already compiled a list of tournament credits that would be the envy of many a mere master. He has been one of America's most highly rated young players for several years and is now earning out a place for himself among the ranks of the country's top adult professionals.

Benjamin's first successes came in scholastic play. He has won the state and national Elementary, Junior High and High School championships, and has won six consecutive Manhattan Chess Club Young Junior Invitationals.

Benjamin's list of 1st-place finishes include the 1978 Manhattan Club Championship, the 1979 Marshall Club Championship, the 1979 Continental Open, the 1980 Philador International and the 1980 Atlantic Open.

Victims of "Benjy" include GMs Walter Browne, Heikki Westerinen, and Peter Biyiasis and IMs Andy Soltis, Yasser Seirawan, Vitaly Zaltsman, and John Fedorowicz and others.

Benjamin gained national attention in July 1977 with another kind of "first." He became, at 13 years and 3 months, the youngest master ever — Bobby Fischer was two months older when he became a master 21 years earlier. Though New York Master John Litvinchuk (at 12 years, 7 months) has since eclipsed this mark, Benjamin still claims the title as the youngest American-born master since Litvinchuk came here from the Soviet Union with his family.

In international play, one of Benjamin's best results came last year at the World Under-17 Championship in Belfort, France, where he placed 5th. He has completed requirements for a FIDE master title and has completed some requirements for an IM title.

Both this year and last, Benjamin was the youngest competitor at the Junior Invitational — a circumstance he faces often, and which has allowed him to achieve a kind of consistency few other players can boast of: He has never lost to a player younger than himself in tournament play. ■

Domenici Bill Addresses Teacher

ALBUQUERQUE JOURNAL Thursday, February 10, 1983 A-5

Shortfall in Math, Science

WASHINGTON — Sen. Pete Domenici of New Mexico introduced a bill in the Senate a week or so ago, and by sheer coincidence, out of the clear blue sky, Adm. Hyman Rickover happened to telephone me the next day. Maybe the admiral had his vibes working, he may have suspected that I was about to charge off at flank speed in support of the Domenici bill. Anyhow, his advice was to signal my engines: Slow.

Sen. Domenici is concerned, as all of us ought to be concerned, at the parlous state of math and science education in our country. The Reagan administration also is concerned. The president will propose an extensive program for producing about 7,000 new science and math teachers annually for the next several years.

Comment By
James Kilpatrick
Syndicated Columnist

Adm. Rickover's concerns go in a different direction. He calls himself a "technocrat." Much of his life has been spent in science and mathematics — specifically, in nuclear physics and marine engineering. The point of his telephone call was to warn against crash programs in science and math at the expense of the liberal arts.

"Give me a high school graduate with a well-rounded education," he said, "and the rest will come later."

Very well. The point is well-taken. The scientist who knows his megatons but knows not Mozart is less than a whole person; intellectual breadth is more to be desired than narrow specialization.

Even so, when that has been said, there is much also to be said for the senator and the president. Domenici defined the problem on the Senate floor. Every standardized test for measuring science and math capabilities has shown a steadily declining level of achievement over the past 10 years. Our high school graduates, by and large, simply are not learning their elementary lessons. At community colleges, three out of four math courses are remedial in nature.

Most colleges and universities have reacted to this sorry situation by lowering their admission requirements for both math and science. The difficulty begins in the elementary grades. Domenici cited an international study with sobering findings. American 13-year-olds scored more poorly on a standardized test than their counterparts from England, Japan, Belgium, Australia, France, Scotland and the Netherlands.

The root of the problem, as Domenici and the White House perceive it, lies in the scarcity of qualified math and science teachers who will stay the course in the classrooms. This past September, he says, half of all newly employed teachers were not qualified; they were put to teaching math and science only because qualified instructors could not be found. [illegible] could not be found at an average minimum starting salary of $11,758.

The Domenici bill would provide nearly 2,700 two-year scholarships, each valued at up to $2,500, for college students who would agree to teach in fields of math and science for at least three years after graduation. A separate program would provide Distinguished Teacher Awards annually for about a thousand teachers in elementary and secondary schools. A teacher who had been on the job for up to five years could be nominated for a $5,000 award; a teacher with at least 10 years' experience could receive $10,000.

The administration's slightly more expansive program of scholarships and awards would be supplemented by an effort to recruit prospective teachers from among recent college graduates, retired teachers and teachers in other disciplines. They would return to college at public expense for 12 months to 15 months of new training in science and math. The price tags would range from $24.5 million for Domenici's bill to well over $50 million for the White House plan. The money would be well-spent.

"No senator worries more about the effects of large deficits than I do," said Domenici — and because he is chairman of the Senate Budget Committee it may well be so. But the problem is critical. Either our school system gears up to turn out better-trained scientists, or 20 years down the road the Japanese will beat our brains out. In many areas, sad to say, they're doing that now.

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WRITTEN TESTIMONY FOR SENATE BUDGET COMMITTEE
Hearing Held in Las Cruces, New Mexico
February 11, 1983

Science and Mathematics Teachers' Needs in the Rural Schools

Everett D. Edington
New Mexico Center for Rural Education
College of Education
New Mexico State University
Las Cruces, New Mexico 88003

WRITTEN TESTIMONY FOR SENATE BUDGET COMMITTEE
Hearings Held in Las Cruces, New Mexico, February 11, 1983

Science and Mathematics Teachers' Needs in the Rural Schools

It is widely accepted today that one of the critical needs of education in the United States is that of supplying more mathematics and science teachers for our schools. While the situation is critical throughout the schools of our nation, it is extremely dangerous in our small and rural schools. There are two main reasons for this serious situation in the rural schools in America. The first is that a great many teachers in the past have been reluctant to go to rural schools. The second reason is that a different type of a math or science teacher is needed for the rural schools than in the urban schools. This will be discussed in more detail later in this paper.

Weiss (1978) in the "1977 National Survey of Science, Mathematics and Social Studies Education Highlights Report" indicated that only 22% of the science teachers in the nation felt very well qualified while 60% that they were not well qualified at all. In the area of mathematics, 49% felt they were well qualified, while 46% felt they were not well qualified at all. This situation is true with teachers across the nation. If a survey were taken of just rural teachers, it is my opinion that these numbers of feeling not well qualified would be much, much higher than they are for the total teacher population. There is also some conflict regarding general teacher supply and demand for the future. As reported by Rober Roth in the November-December, 1981 issue of Journal of Teacher Education, much of this confusion results from failure to distinguish among supply and demand data, reports by geographic school settings (urban, suburban, rural), subject area, method of collecting data, and technique used for projection. He went

on to say that the states currently experiencing the greatest teacher shortage are Alaska, Colorado, Georgia, Indiana, Missouri, North Dakota, South Dakota, Texas, and Wyoming. In each of these states, there are large numbers of rural people. Some of them, such as Alaska, Colorado, North Dakota, South Dakota, and Wyoming are primarily rural states. He again reported that subject areas where shortages exist more often than in other areas were mathematics, science, agriculture, special education, industrial arts, and vocational, techincal subjects.

In a personal telephone conversation on January 7, 1983, Mr. Dakay, the science consultant from the Office of Public Instruction in Idaho, noted that particularly in the small schools many teachers are teaching mathematics or science for which they are not certified. They are allowed to teach for a set time at the end of which they must have taken the needed coursework. He said that in many cases Idaho's teachers are moved from the junior high school to teach high school science or mathematics courses. Although these teachers are not qualified in all areas of science, most have a fair background and it does not require a great deal of coursework through the colleges to receive certification. To fill the vacant slots left in the junior high school, an elementary teacher who has an interest in science has been used. Mr. Dakay was very concerned about what the results of such a practice were on the students.

Some states feel that most of the teachers teaching science and mathematics in the rural schools may have met the certification requirements, but some are concerned about whether they are qualified. In another telephone conversation with Mr. Dan Dolan of the Montana Office of Public

Instruction, he said there were very few teachers who are not certified in their areas of teaching. He did, however, have reservations about the qualifications of the teacher versus certification. He said there may exist many cases in the small schools where a person with a minor in mathematics or science is teaching in the area beyond the scope of their second subject area training.

J. Guay (1980) in a study done in Southern Alberta entitled "Biology and Life Science Classroom Teaching Environment in Southern Alberta" reported that 20% of all the teachers who responded to the survey reported having no biology courses in their post secondary academic backgrounds. Nearly 30% reported having no zoology courses. Botany and chemistry courses were absent from the backgrounds of 44% of the biology and life science teachers in the survey of rural teachers. In a comparison of the urban versus rural, he also found that the urban teachers were better prepared than the rural teachers.

In a report by Beck and Smith (1982) when they surveyed the needs of 587 school superintendents in Texas in schools having fewer than 1000 students, they found that in the top ten of the greatest single needs in the district the greatest was having qualified mathematics teachers.

Generalists versus Specialists

There is a trend among colleges training teachers for the individual to become much more specialized. This continues in the training of mathematics and science teachers for the rural schools. The dangers which exist today will become even more volatile in the future. We know

that the rural teacher is the generalist rather than a specialist, and due to the small schools and isolation this will continue in the future.

Colton (1981) in a paper entitled "The Science Program in Small Rural Secondary Schools" reported that the lack of specialists in each of the separate scientific disciplines, such as biology, chemistry, science, or physics, could be a grave disadvantage if these separate disciplines are required to have specialists and only one or two are available. He goes on to advocate that if science courses based on specific themes, such as energy crisis are taught and one or two teachers with sufficiently broad training can cope especially if they are free to design courses based on familiar, local situations and resources.

Guay (1980) in the Canadian study, stated that teachers of biology and life science courses in urban locations reported more specialized instructional assignments than their rural counterparts, especially at the senior high level. At this level all urban respondents reported teaching only biology and life science. Only one of six rural senior high teachers, one of the 13 teachers in combined junior-senior rural locations could make this claim. The senior high teachers in rural areas taught up to four of their subjects in addition to biology and life science. The teachers in rural combined junior-senior high schools averaged three other subjects.

Colton (1981) indicated that the job of teaching science in small, rural high schools can be very different from that in the large urban

school where specialists in several scientific disciplines are involved. What is needed in the rural school is not the specialized physicist, chemist, biologist, or earth scientist, but a teacher who has a sound grasp of the basics of all these to understand their relationships and interpret the rural environment to guide the investigation at the level necessary to satisfy the needs of high school students. For this purpose a good ground in biology and basic physical science is necessary with some understanding of the earth sciences and perhaps basic chemistry. Teacher education institutions must be aware of the needs of combining teaching endorsements for the rural science and math teacher.

In the Texas study done by Beck and Smith (1982) of the 21 combinations of subjects needed by teachers, 7 of these were combinations of either math or science. Also, of the top six they found four combinations needed in math and science with other subjects. Guay (1980) indicated that the subjects most likely to be combined for biology teachers in rural senior high schools were chemistry and mathematics. In the rural junior high locations almost every subject in the curriculum was included in at least one teacher's assignment.

Recommendations and Conclusions

Any program for the state, local, or federal levels designed to produce more math and science teachers should recognize the special needs of the small, rural, and isolated school. Rural teachers can expect generalized teaching assignments with a greater diversity of subject matter responsibilities than teachers in larger, urban settings. There

is a tendency to retain the small, rural schools. These problems will remain with us for a long time. It is also recognized that by making these small schools bigger, it does not necessarily make them better. We must develop programs and teachers that are qualified to teach in the rural settings. Whatever changes made to accommodate the science program to local needs in the rural community, they must be consistent with good science and good education. Science teaching must play its part in developing those skills and attributes which we expect to find in an educated person, and wherever a base a pathway to learning may be, must lead the student to an understanding of the basic concepts of science. Colton (1981) also goes on to state that in the future more teachers specifically trained for the rural schools should be available. Outside resources will also have to be available to support rural teachers who wish to improve their teaching of mathematics and science.

The science and mathematics education needs of 30% of our students living in rural America should not be neglected. If they are not to continue to be the people left behind, the funding programs and training programs must recognize the differences of the teachers going to the rural areas. There is a strong need for generalists rather than specialists, and a person should be flexible enough to teach a number of different areas.

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